Two Silver Medals, Paris, 1878.
The Chilian Medal, Santiago, 1875.

THE GLENBOIG STAR FIREBRICK WORKS,

Near COATBRIDGE, N.B.

JAS. DUNNACHIE,
2, *West Regent Street, Glasgow.*

Contractor to Her Majesty's Government.

Manufacturer of Fire Bricks for Steel, Iron, Brass, Gas, Chemical and Glass Furnaces, Copper roasting, calcining and refining furnaces. The special bricks for the Siemens regenerative gas-furnace (this is the brand recommended by Dr. C. W. Siemens). Bessemer tuyeres, runners, plugs and stoppers. German tubes. Gannister of highest quality, ground fireclay. No other firebrick combines such a high degree of infusibility with the perfect absence of cracking and splitting up under sudden cooling.

Each brick bears the registered Trade Mark.

Trade J Star Works ✻ Glenboig D Mark

Quotations, Illustrated Catalogues, &c., on application.

Shipping ports, Glasgow, Grangemouth, Leith, Granton, Boness, &c.

London Agents: Messrs. Doulton and Co., Lambeth Pottery, and Crown Wharf, Victoria Park, E.

Wheatley Kirk, Price and Goulty. Established 1850.
MECHANICAL VALUERS, AUCTIONEERS AND ARBITRATORS.
Head Offices—Albert Square, Manchester.

Partnerships. — Gentlemen (Practical Engineers) desirous of entering established Engineering concerns, are invited to communicate with the undersigned, who have numerous bona fide establishments open to admit such. References are given and required.—Wheatley Kirk, Price and Goulty, Albert Square, Manchester.

Engineering Firms of Good Repute, open to admit partners, or desirous of selling outright, are requested to communicate with the undersigned, who have numerous clients open for such.—Wheatley Kirk, Price and Goulty, Albert Square, Manchester.

By order of the Devisee in Trust under the will of the late Wm. James, Esq.—Gloucestershire, in the Forest of Dean.—Valuable Mining Properties, extending over an area of about 200 acres (of which about 30 acres have been partially worked), and containing an abundance of hematite iron ore of rich quality, yielding a very high percentage of pure metal, together with the joint ownership with Messrs. Henry Crawshay and Sons of a private tramway, communicating direct with the Severn and Wye Railway.

Messrs. Debenham, Tewson, Farmer and Bridgewater will SELL, at the Mart, on TUESDAY, May 11th, at 2, in three lots (unless an acceptable offer or offers be previously made), the following important IRON MINES:—

Lot 1.—The Oakwood Mill Deep Level, situate near Bream, about three miles from Lydney and four from Coleford. Held under an award from the Crown for 500 years from March, 1825, at a dead rent of £15 per annum and a royalty of 4d. per ton on all ore raised in excess of 900 tons per annum. A portion of this lot is sub-leased for seven years, at a certain dead rent of £200 per annum, and a royalty of 1s. 9d. per ton upon all ore in excess of 2285 tons per annum. The remainder is in hand. Also an undivided Moiety of the Oakwood Tramway, a valuable property, 1¾ mile in length, from which a large income is derived in the shape of tolls.

Lot 2.—The Scar Pit, a freehold grant or gale from the Crown, overlying a portion of the Oakwood Deep Level Mine. This lot is subject to a dead rent of £5 per annum, and a royalty of 4d. per ton on all ore over 300 tons per annum. With possession.

Lot 3.—The Frog Pit, a freehold grant or gale from the Crown, overlying a portion of the Oakwood Deep Level Mine. Dead rent £5 per annum, royalty 4d. per ton on all ore exceeding 300 tons per annum. With possession.

The mines are adjacent to the extensive works of Messrs. Henry Crawshay and Sons, at Parkend. Particulars of W. Caister, Esq., Solicitor, 8, New-inn, Strand; of J. J. James, Esq., The Hoggins, St. Briavels, near Coleford; of Mr. Wm. Trafford, Mining Engineer, Bream, near Lydney; and of the Auctioneers, No. 80, Cheapside.

IN LIQUIDATION.

To be Sold by Private Treaty, as a going concern, on the Great Northern Line of Railway, a well-established ENGINEERING BUSINESS, comprising the following branches, viz:—

The Manufacture of Stationary Engines and Boilers.
Portable and Combined do.
Agricultural Implements of all classes,
And especially the Manufacture of Wrought Iron Cranks, for which a complete Plant of Patent Machinery has been put down; also General Iron Founding with all the Appliances for carrying on and extending a first-class trade.

The Machinery and Tools are by well-known makers, and the new Buildings are erected upon land secured on a 999 years' lease.

Full particulars can be obtained from Mr. Isaac Jenks, of Wolverhampton; Mr. Thomas Leman, Accountant, Nottingham; or Messrs. Corser, Fowler and Langley, Solicitors, Wolverhampton.

Lathe Treadle Gut, with back gear, screw-cutting, Holtzapffel's chucks, tools, change wheels, 4½in. centre, 5ft. bed, price £[illegible] equal to new, cost £120; can see it by appoi[illegible], 10A, Guildford Road Greenwich.

CoD.N. [illegible] Pile Driving [illegible] E. For price and particulars, [illegible] Bolton and Co., 3, Temple Gardens, Temple, [illegible]

---

200 TONS NUTS, BOLTS, &c.,

ALWAYS IN STOCK.
SAMUEL MARSDEN & SON.
LONDON ROAD, MANCHESTER.
Patentees and Makers of Special Machinery for Bolt, Spike and Nut Making.

GRAHAM STREET FOUNDRY AND NINE SHOPS ADJOINING.—BRADFORD.

IN THE MATTER OF E. C. RHODES & Co.'s ASSIGNMENT.

By Mr. J. BUCKLEY SHARP, at the Talbot Hotel, Bradford, on THURSDAY, May 13th, 1880, at Six o'clock in the Evening (for Seven precisely), in One Lot,

The well-known and Extensive Foundry, for many years past in the occupation of Messrs. E. C. Rhodes and Co., and now of the Trustees under their Assignment, and called the "Graham Street Foundry," having frontages to Graham Street, Augustus Street, and Ernest Street, in Bradford, and comprising Foundry, Fitters' and Joiners' Shops, Model Rooms, Engine and Boiler Houses, convenient suite of Offices, Stabling and other buildings.

The premises were specially arranged for a foundry, but are readily adaptable for any works of a mechanical nature, and form a most desirable site for business premises. The plant is in a capital working condition, and immediate possession can be given of the whole.

The fixed machinery and plant, of which a schedule will be produced at the sale, is not included in the lot, but the purchaser will have the option of taking the same at a valuation, as provided by the conditions of sale.

Also, the Nine SHOPS, with the Hay Chamber and Blacksmiths' Shop adjoining, and fronting to Graham Street aforesaid, and forming the northern boundary of the foundry premises, and close to one of the entrances to St. James' Market. These shops are excellently built, and all let, producing a low gross rental of £136 10s. per annum. The tenants are disposed to accept leases of their respective holdings.

The whole estate forms a compact lot, containing an area of 2841 square yards, contiguous to the sidings of the Great Northern Railway, at Hammerton Street. Part of the purchase money may remain on mortgage if required.

For further information and permission to view the premises, apply to Mr. Frederick Ronnfeldt, Accountant, Hustlergate: Mr. R. R. Priestley, Accountant, 5, Little Horton Lane; the Auctioneer, Well Street; or to

R. NEWTON RHODES, Solicitor.
Swan Arcade, Bradford.

For Sale, about 250 Tons BESSEMER STEEL, consisting Ingot Ends, &c.—

60 Tons	30	W STEEL RAILS,	new.
50 ”	40	” ”	”
25 ”	42	” ”	”
80 ”	50	” ”	”
70 ”	45	D IRON RAILS,	new.
150 ”	40	” ”	”
40 ”	35	” ”	”
80 ”	50	” ”	”

With all Fastenings complete if required.—Apply, "Rails," Office of this Journal.

Tenders will be received until 2 o'clock on THURSDAY, the 6th May, for 136 tons of IRON HOOPS. Manufacturers only will be accepted.

Forms of Tender, containing conditions of contract and all particulars, may be obtained on personal application at this office, or by letter, addressed "Director of Navy Contracts, Admiralty, Whitehall, S.W.

JOHN COLLETT,
Director of Navy Contracts.
Contract Department, Admiralty, Whitehall, S.W., 23rd April, 1880.

BY ORDER OF THE SECRETARY OF STATE FOR INDIA IN COUNCIL.

The Director-General of Stores for India is prepared to receive TENDERS from such persons as may be willing to SUPPLY for Indian State Railways 5ft. 6in. GAUGE IRONWORK, FITTINGS, &c., for Railway Carriages and Brake Vans.

The Conditions of Contract may be obtained and the Drawings inspected on application to the Director-General of Stores, India Office, Westminster, S.W., and Tenders are to be left at his office at any time before two o'clock p.m. on WEDNESDAY, the 19th May, 1880, after which no Tender will be received.

A. ABERCROMBIE JOPP,
Director-General of Stores.
India Office, 28th April, 1880.

IRON MANGANESE AND SPATHOSE ORES.

Messrs. Thomson & Wright, 10, Cornhill, London, are prepared to enter into Contracts for supplying in large quantities the best SPANISH IRON ORES; also rich MANGANESE and SPATHOSE ORES.
Particulars on application.

TO BE LET OR SOLD.

The Broughton Hall Iron-Works, near Wrexham. Lately worked by Mr. Plant, who has retired in consequence of illhealth.—For further particulars apply to Charles Ryland and Son, Metal Brokers, 6 and 7, Exchange Buildings, Birmingham.

To Shippers, Engineers, Contractors, Ironmongers, &c.—Public Sale by BOOTH AND SONS, at their Sale Rooms, 26, Old Change, St. Paul's, on FRIDAY, 7th May, at 2 precisely, on account of whom it may concern, 30 NEW PATENT ROTARY CYCLOPS AND KEYSTONE FORGES, in single lots, 24 New Iron Sack Barrows fit for Bales of Rags, Wool, Hops, &c., 3 Sizes, 300 Padlocks, 2 Office Tables, Pigeon-hole, Office Bookcase, Copying Machine, &c. Catalogues of Booth and Son, Auctioneers, 11, Cloak Lane, E.C.

Waterside Premises.— WAREHOUSES to LET with or without frontage to River Thames, in portions to suit applicants.—Apply, 4, Upper Thames Street, London, opposite "Times" Office.

H. AUGUSTUS GUY AND COMPANY,

Government Contractors and Medallist
STEEL CONVERTERS AND REFINERS.
Sole proprietors and manufacturers of

GUY'S 'INVINCIBLE,' 'RELIABLE,' & 'MINING' TOOL STEEL.

Steel Forgings and Castings of every weight and Section.

The unequalled excellence and undeviating uniformity of these famous Brands secure an immense economy in the workshop and the mine.

Inventors and Sole Makers of the

"IMPERIAL" METAL.

An economical and efficient substitute for ordinary brass and gun metal, being much more durable and cheaper than these materials.

GUY'S "TRUE" BOILER CLEANER & FUEL ECONOMISER.

For removing and preventing incrustations in land and marine boilers. It prevents oxidation, secures a material saving in fuel, and doubles the life of the Boiler.

Chief Offices:
11, CLOAK LANE, CANNON STREET, LONDON, E.C.

Works.—The "Imperial" Metal and Steel Works Peckham, London, S.E., and Sheffield.
Full descriptive price Lists on application.

Leroys Improved Patent Non-Conducting Composition for Coating Boilers, Steam Pipes, and other highly-heated surfaces. Superior to Felt or any other composition, for economy, durability, adhesiveness, and effectiveness. Prevents the radiation of heat, saves fuel, increases the power of steam, and keeps the stoke-hole and engine-room cool. It will at once show a leak, and cannot catch fire. Used all over the world.

F. Leroy and Co., Sole Manufacturers, 72, Gray Street, Philpot Street, Commercial Road, E., and Griffith Street, Lower Broughton, Manchester

---

The undersigned undertakes for Austria-Hungary the representation of first-class manufacturers, or exporters of steelware, Birmingham and Sheffield hardware, &c. Besides the knowledge of the trade and the market he has extensive connections of many years' standing amongst buyers. Highest references.—J. Keil, I, Tiefen-Graben, 15, Vienna.

CITY AND GUILDS OF LONDON INSTITUTE FOR THE ADVANCEMENT OF TECHNICAL EDUCATION.

The Executive Committee of this Institute are prepared to award a limited number of free admissions to the Classes in Practical Fine Art and in Metallurgy, held in King's College, London, under the direction of Professor P. H. Delamotte and Professor A. K. Huntington.

In the selection of candidates for admission, preference will be given to Apprentices, Artisans, Designers and Artistic Tradesmen.

The King's College Term commences on Thursday, April 15th.

Further particulars with respect to these courses can be obtained from J. W. Cunningham, Esq., Secretary, King's College, London.

Applications for admission to be sent to City and Guilds of London Institute, Gresham College, E.C.

PHILIP MAGNUS,
Director and Secretary.

DER PRACTISCHE

Maschinen-Constructeur.

Zeitschrift für Maschinen-und Mühlenbauer, Ingenieure und Fabrikanten.
Unter Mitwirkung bewährter Ingenieure und anderer Fachmänner des Inund Auslandes
herausgegeben von
Wilhelm Heinrich Uhland,
Civil-Ingenieur und Patent-Anwalt in Leipzig.

Verlag von BAUMGARTNER'S BUCHHANDLUNG in Leipzig.

Inhalt des 8. Heftes: Combinirte Gattersage fur Bauholz und Breter.—Tabelle uber Dimensionen von 4-, 8-, 10-, 12- und 16 pferdigen Locomobilen.—Tweddel's Maschinen fur Blechbearbeitung.—Die elektrische Eisenbahn von Dr. W. Siemens.—Apparate zum Heben der Eisenbahngeleise.—Selbstthatigen Schmierapparat fur lose Riemenscheiben und compacte Schmiere von A. H. E. Bachmann.—Pracisions-Regulatoren der Harzer Actien-Gesellschaft.—Die „Gippeswyk"-Dampfmaschine von E. R. and F. Turner, in Ipswich, England.—Instrument zum Aufzeichnen der Parable.—Die Dampfkessel-Revisions-Vereine in Deutchland. — Ueber Zahnradbahnen. — Das Emailliren gusseiserner Geschirre.

Der „Practische Maschinen-Constructeur" erscheint in halbmonatlichen Heften und kostet pro Quartal (6 Hefte mit Holzschnitten und 24 autograph. Tafeln, sowie vielen Skizzenblattern) 6 Mark 75 Pfg. Einzelne Hefte werdennicht abgegeben! In London bei Herrn Williams and Norgate, 14, Henrietta Street, Covent Garden.

AVIS IMPORTANT.

Le Journal "Iron" (le Fer) traite de toutes les matières relatante au Commerce et à la fabrication du fer. Il donne les prix-courants des spécialités de Birmingham, Sheffield et districts voisins. Les colonnes en sont ouvertes aux rapports scientifiques et commerciaux publiés sur les métaux et sur la quincaillerie de tous les pays du monde. On y trouvera des comptes rendus et des appréciations étendues sur la fabrication du fer et sur toutes matières ayant rapport à la métallurgie, aux hauts-fourneaux, etc., ainsi que des descriptions variées sur les diverses usines. Le journal "le Fer" ayant une circulation considérable parmi les manufacturiers, négociants et exportateurs des deux continents est de la plus haute importance pour tous ceux qui ont à insérer des annonces industrielles ou métallurgiques.

Le journal se publie tous les Vendredis.

Le prix du numéro est de of. 60 c. et le coû de 'abonnement est de 38 f. par an., frais de port compris.

On est prié d'adresser toutes communications au Directeur de l'Iron, No. 161, Fleet Street, London, E.C.

CHEMISTRY.

Henry S. Bell, F.C.S., Associate of the Royal School of Mines, London, &c., Analytical and Consulting Chemist. Office and Laboratories, 46, High Street, Sheffield.

Analyses of Iron and Steel, Spiegeleisen, Manganese, Ores of all kinds, Nickel and Copper, Alloys, Coal and Coke, Fireclays, &c., performed on reasonable terms.

Gentlemen visiting Sheffield for the purpose of study will find every convenience in the Laboratories at the above address.

Wanted, Price Lists and Catalogues from manufacturers and others of supplies for GLASS, IRON AND STEEL AND CHEMICAL WORKS, only such as are apt to compete with those of American production, by the undersigned, who has an established trade with above works in the United States. References to first-class firms in England, Germany and America forwarded on application, or can send cash with orders. Quote lowest prices f.o.b. ocean vessels, and send small sample, together with testimonials and your telegram address.—Rudolph Frank, Importer and Commission Merchant, 220, Fulton Street, New York, U.S.A. Telegram Address: "Fireclay, New York."

To Ironmasters and Others.—For Sale a large quantity of HAND LEATHERS and PIG-IRON LIFTERS LEATHER APRONS.—For samples and prices apply to John Nicholson and Co., 208, Vauxhall Road, Liverpool.

NOTICES,

ORES, MINERALS & METALS,

IMPORT AND EXPORT.

The only house in America giving Special Attention to Manganese and Manganiferous Iron Ores.

ADDRESS;
WILLIAM D. MARVEL,
NEW YORK.
Telegrams: "Marvel, New York."

JOHN BELLAMY,

BYNG STREET, MILLWALL, LONDON, E.
MANUFACTURER OF
WROUGHT IRON TANKS AND CISTERNS.

Cattle, Sheep, and Pig Troughs, Cart Bodies, Corn, Flour, and Sack Bins, Funnels, Shoots, Hoppers, Boilers, and every Description of Wrought Iron work either painted or galvanised.

The only BELLAMY in the Trade.

No connection with any other house trading under this name.

DIAMOND BORING.

ARTESIAN WELLS bored STRAIGHT and TRUE—Large and small diameters—easy to line and put down Pumps—Tenders given for Wells, Pumping Machinery, and Engines, complete.

PROSPECTING FOR MINERALS to any depth—The only system by which a true section of the strata can be obtained from the cylindrical cores taken out.

Total boring by this system in Great Britain to end of last year, 104,000 feet.

For terms apply to John Vivian, C.E., Whitehaven, Cumberland.

Spring Hill, Birmingham, BRASS AND COPPER ROLLING-MILLS. BRASS AND COPPER WIRE MILLS.
BRASS AND COPPER LOCOMOTIVE, MARINE, AND GAS TUBE MILLS. CARTRIDGE METAL MILLS.
Proprietors:
GLYDON, SHORTHOUSE and GLYDON.

New Edition.

"How to Make Money by Patents." Free, by post, 14 stamps.—Barlow and Young, Patent Agents and Consulting Engineers, 23, Southampton Buildings, W.C.

A SILVER MEDAL, PARIS, 1878.
For Excellence of Quality,
WAS AWARDED TO

THE GLENBOIG FIRE CLAY COMPANY,

ESTABLISHED 1836.
Office: 68, BATH STREET,
GLASGOW.

MANUFACTURERS OF FIRE BRICKS FOR HIGH HEATS AND SUDDEN CHANGES OF TEMPERATURE.

Repairs in smelting, puddling and other furnaces occasion such expense and loss of time that it becomes a matter of the greatest necessity to build these furnaces of bricks possessing the highest refractory power. Our experience shows that where ever our bricks have been introduced, they have superseded those of local make. They are specially adapted for Siemens' regenerative gas furnaces; for blast, puddling and glass furnaces; every description of furnace exposed to the most intense heats and sudden changes of temperature, as they do not crack and drop when quickly cooled or heated. References can be given both in Great Britain and the Continent to many of the largest firms in the iron, steel and other trades where our fire bricks are in constant use.

Quotations given delivered at Antwerp, Rotterdam, Bremen, Hamburg, Havre, Dunkirk, &c.

Shipping ports, Glasgow, Leith, Grangemouth, Granton, Boness, &c. &c.

Published by the Proprietors, every Friday, at their Offices, 161, Fleet Street, E.C., in the City of London, where all communications, whether for Editor or Publisher, are to be addressed.
Printed for the Proprietors by Bradley & Company, 12, 13 and 14, Fetter Lane, London, E.C.—April 30, 1880.
Copies of IRON can be obtained through all Newsagents and Vendors, and at all Railway Bookstalls.

~~Col Pemberton~~
~~Mr Hossey~~
Mr Stone

FOREIGN EDITION.

IRON.

An Illustrated Weekly Journal of Science, Metals, and Manufactures in

IRON AND STEEL.

ESTABLISHED IN THE YEAR 1823 AS "THE MECHANICS' MAGAZINE."

CONDUCTED BY PERRY F. NURSEY, C.E.

PUBLISHED EVERY FRIDAY, FOR CIRCULATION IN THE UNITED KINGDOM, AND ON THIN PAPER (UNDER 4 OZ.), FOR FORWARDING TO ALL PARTS OF THE WORLD.

No. 382. VOL. XV. LONDON, FRIDAY, MAY 7, 1880. PRICE, WITH SUPPLEMENT, ONE SHILLING. Registered as a Newspaper for Transmission Abroad.

CONTENTS.

(For Contents see Correspondence column).

LOWOOD'S
GROUND CANISTER.
For Lining all kinds of Furnaces, and
NON-EXPANSIVE GANISTER BRICKS,
Superior to ordinary Silica, and equal to three times of Fireclay brick.
J. GRAYSON LOWOOD & CO.,
78, ATTERCLIFFE ROAD, SHEFFIELD.

CRANE'S PATENT OIL,
FOR CYLINDERS & VALVES OF COMPOUND SURFACE CONDENSING ENGINES.
As Supplied to H.M. Navy and the Principal Steamship Companies. Sole Manufacturers,
P. MOIR CRANE & CO.
BANK ST., MANCHESTER,
25, WATER STREET, LIVERPOOL,
And 131, FENCHURCH ST., LONDON, E.C.

ASBESTOS.
ASBESTOS ENGINE PACKING,
ASBESTOS MILLBOARD JOINTING,
ASBESTOS BOILER COVERING,
ASBESTOS CEMENT,
ARE UNRIVALLED.
SOLE PATENTEES & MANUFACTURERS
THE PATENT ASBESTOS MANUFACTURE COMPANY, LIMITED,
31, ST. VINCENT PLACE, GLASGOW; and 10, MARSDEN STREET, MANCHESTER;
From whom Price Lists and all Information can be had.

GEO. ANGUS AND CO.
Manufacturers and Dealers in every description of
LEATHER, INDIA-RUBBER, AND GUTTA-PERCHA GOODS
FOR GENERAL MECHANICAL PURPOSES
Contractors to the Admiralty.
ST. JOHN'S LEATHER AND INDIA-RUBBER WORKS,
NEWCASTLE-ON-TYNE.
AND 10, THOMAS STREET, LIVERPOOL.
London Agency:—187, UPPER THAMES ST.

J. VEITCH WILSON AND CO'S
SPECIAL LUBRICATING OILS,
CYLINDER OILS,
POLAR OILS,
CLIMAX OILS,
Combine Efficiency, Safety, and Economy.
Samples, prices, and further particulars, on application.
Office: 5, ST. VINCENT PLACE, | GLASGOW.
Works: 258, DOBBIE'S LOAN |

JOHN SPENCER AND SONS,
NEWBURN STEEL WORKS, NEWCASTLE-ON-TYNE,
SPRINGS, BUFFERS, STEEL CASTINGS, FORGINGS, TOOL STEEL, FILES, SPRING STEEL, SIEMENS STEEL BLOOMS & BARS

Steam Hammers, with or WITHOUT GUIDES, Hand-worked or Self-acting. Machine Tools for Shipbuilders or Boiler-makers.
DAVIS AND PRIMROSE, Leith.

BIRMINGHAM
PATENT TUBE COMPANY.
SMETHWICK TUBE WORKS, Near BIRMINGHAM.
London Office—77, Cannon Street, E.C.
LAP-WELDED, IRON, STEEL, HOMO METAL, BRASS & COPPER BOILER TUBES, &c.

MAISON FONDÉE EN 1844.
CALEDONIAN TUBE COMPANY,
COATBRIDGE, PRÈS GLASGOW.
FABRICANTS DE
TUBES EN FER A RECOUVREMENT BREVETES POUR
CHAUDIERES MARINES, DE LOCOMOTIVES, &c.
à cause des arrangements spéciaux à l'usine, nous sommes prêts en toute occasion à fournir rapidement aux commandes, et de faire à la hâte toutes espèces de réparation.

MAYBURY, MARSTON AND SHARPE,
FORGE DE LA PERSEVERANCE
(Perseverance Ironworks)
PENDLETON, MANCHESTER, ANGLETERRE
Marque de fabrique déposée
M.M. & Co.
Spécialité de
Feuillards d'emballage en fer ou en acier, communs ou à charnière;
Feuillards de tonnelerie droits ou coniques;
Fer battu, qualité Extra best, pour fers à cheval.
Rondelles en fer pour tous les emplois.

ESCHERICH'S GAS KILN,
As described in IRON, April 16th; the only successful Gas Kiln for burning goods of a delicate colour, facing bricks, fire bricks, pottery and china, &c., at a great saving in fuel. For particulars, apply to
HERMANN WEDEKIND,
158, FENCHURCH ST., LONDON, E.C.

ISAAC JENKS & SONS,
Manufacturers of
SPRING STEEL, CAST STEEL, &c.
RAILWAY SPRINGS, COACH SPRINGS, SHEET AND BAR IRON, TAPER BRAKE, LEVER BARS, &c.
Minerva & Beaver Works, Wolverhampton.
Brand, Steel JENKS. Brand, Iron BEAVER.

INDIARUBBER MANUFACTURES.
THE
NORTH BRITISH RUBBER COMPANY
(LIMITED), OF EDINBURGH,
Are extensive and bona-fide Manufacturers of Indiarubber Furnishings for
TEXTILE MANUFACTURERS, CHEMICAL MANUFACTURERS, ENGINEERS, CONTRACTORS, DYERS, PAPER MAKERS, MILLERS, &c., also for STEAMSHIPS, RAILWAYS, COLLIERIES, IRONWORKS, and for AGRICULTURAL PURPOSES, &c., &c.
Warehouses.—London: 4, CANNON STREET.
Manchester: 6, CHARLOTTE STREET.
Glasgow: 13, Oswald Street.

THE RAILWAY
WHEEL AND AXLE WORKS COMPANY,
STOURBRIDGE.
MANUFACTURERS OF WROUGHT AND CAST IRON BOSS
RAILWAY WHEELS AND AXLES.
ALSO FORGINGS AND CASTINGS.

Engineering Partnership.—A Gentleman desires to enter an Engineering Establishment (London preferred), with a view to PARTNERSHIP. He has experience as mechanical and civil engineer in England and on the Continent, and has also good connections among civil engineers and leading export firms. Could introduce £10,000 or more at once.—Address, X. Y. Z., care of James Bird, Esq., 2, Laurence Pountney Hill, Cannon Street, E.C.

Patents.—"Patent Law in PLAIN ENGLISH." By W. P. THOMPSON, C.E. 1878 Edition. British portion, 6d.; all countries, 2s. 6d.

Published by W. P. THOMPSON and Co., Patent Solicitors and Negotiators for the Sale of Patents in all countries, 323, High Holborn, London, and 6, Lord Street, Liverpool. "It is the handiest synopsis of the subject we have seen, and we commend it to the notice of every intending patentee."—IRON.

"Machinery Market."—A Monthly Business Journal. Everyone using Machinery, selling Machinery, buying Machinery, or interested in Machinery in any way should see "The Machinery Market." Single copy post free, 6d. Publishers and Proprietors—JAMES WADHAM, Sen., and Co., Darlington (England).

PATENT AGENT.

Patents.—Mr. J. C. Mewburn, Patent Agent and Consulting Engineer. Patents obtained at Home and Abroad. Designs and Trade Marks Registered. Specifications and Disclaimers prepared. Opinions given on cases submitted. A Handbook, giving full information as to the costs of Patents, &c., post free.
Office for Patents, 169, Fleet Street, London.

B. & S. MASSEY, MANCHESTER,
PATENT
STEAM HAMMERS,
Received the ONLY Prize Medal, Paris, 1878.
60 to 100 usually in Construction.
HASSE'S PATENT
POWER HAMMERS,
The best Friction Hammer made.

Wales and West of England.
The Leading Daily and Weekly Newspapers, and the Great Advertising Media.

SOUTH WALES DAILY NEWS. Published every Morning.—Price 1d.

CARDIFF TIMES AND SOUTH WALES WEEKLY NEWS. 72 Columns. Published every Friday Morning (Second Edition on Saturday Morning).—Price 2d.

The SOUTH WALES DAILY NEWS is one of the Largest Daily Papers in Wales and the West of England. It has a very large and constantly increasing circulation, and is distributed throughout an unusually extensive area, which comprises:—Glamorganshire, Monmouthshire, Carmarthenshire, Pembrokeshire, Cardiganshire, Breconshire, Radnorshire, Forest of Dean, Bristol, Gloucester, Hereford, and the West of England. The SOUTH WALES DAILY NEWS circulates in every Town and Village of this immense district, and it is unsurpassed as a General Advertising Medium—particularly for communicating with the Commercial, Mining, Manufacturing, Shipping, and Agricultural sections of the community.

The CARDIFF TIMES & SOUTH WALES WEEKLY NEWS has for over twenty years been the recognised head of the Weeky Press of Wales. It consists of seventy-two long columns, and is one of the Largest News-Sheets in the Kingdom. It has a very large and continually increasing circulation, and is published throughout the same extensive district as the South Wales Daily News.
Proprietors: D. DUNCAN AND SONS.
Chief Offices: CARDIFF.

Iron and Steel, a Work for the Forge, Foundry, Factory, and Office, containing ready, useful, and trustworthy information for Ironmasters and their Stocktakers; Managers of bar, rail, plate, and sheet rolling mills; Iron and Metal Founders; iron ship and bridge builders; mechanical, mining, and consulting engineers; architects, contractors, builders, and professional draughtsmen. By CHARLES HOARE. Eighth Edition, revised, and considerably enlarged. Pocket size, 400 pp., bound in leather, with elastic band, 6s. (postage 3d.).

"Of invaluable service to heads that devise and hands that work in the forge, foundry, factory, or office."—*Iron Trade Circular* (Ryland's.)
CROSBY LOCKWOOD & Co., 7, Stationers' Hall Court, London, E.C.

IRON TRADES' COMPANION.
Price 9s., strongly bound in leather (postage 4d.)

The Iron and Metal Trades' COMPANION: Being a Series of Tables upon a new plan for expeditiously ascertaining the value of goods bought or sold by weight, from 1s. per cwt. to 112s. per cwt., and from one farthing per pound to 1s. per pound. Each table extends from one pound to 100 tons. To which are appended many useful Rules, Tables, and Memoranda. By THOMAS DOWNIE.

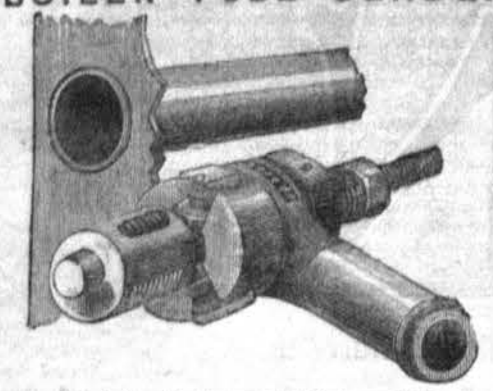
"Handy and convenient, and the arrangement, to our mind, is in advance of its predecessors."—IRON.
CROSBY LOCKWOOD & Co., 7, Stationers' Hall Court, London, E.C.

Locomotive Tank Engines of all sizes and for all gauges. Several in stock and in progress.—FLETCHER, JENNINGS and Co., Lowca Engine Works, Whitehaven.

ROLLED MALLEABLE IRON JOISTS AND GIRDERS.

HENDERSON AND GLASS,
IRON MERCHANTS, LIVERPOOL,
Have always on hand a large Stock of **ROLLED MALLEABLE IRON JOISTS and GIRDERS** of all sizes up to 20 Inches deep and assorted lengths; also, all other descriptions of **Iron for Engineers, Boiler Makers, Shipbuilders, &c., in Bars, Plates, Bulb Iron, Angles, Tees, Jackstay Channel, Hoops, Sheets, Rods, &c. Iron and Brass Boiler Tubes.**
SPECIAL QUOTATIONS FOR SPECIFICATIONS.
Section Sheets, &c., on application.
OFFICES AND WAREHOUSES, 18, 20, AND 22, VULCAN STREET.

D. L. SELKIRK'S
BOILER TUBE BEADER.



For further Particulars and Prices, apply to

D. L. SELKIRK,
CONSULTING MARINE ENGINEER AND SURVEYOR,
9, LONDON STREET, LONDON, E.C.

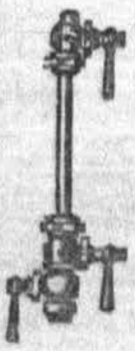
HEPBURN AND GALE,

TANNERS,
LONG LANE SOUTHWARK, LONDON
MANUFACTURERS OF WIRE-SEWN AND OTHER
Leather Machine Bands.
LEATHER HOSE PIPES
Cups and Hydraulic Leathers, Prepared Hide Laces, Strap Butts, Sole Butts, Pipe Butts.

Their **Waterproof Leather** for **Pump Buckets** retains its shape, and remains perfectly solid in water. It is in general use in Mines and Collieries, and may be had of all Dealers in Leather. Each Butt bears the following stamp.

HEPBURNS'
PUMP LEATHER
WATERPROOF

Prize Medals for 1851, 1855, and 1862.



J. B. TREASURE and CO.

INVENTORS OF THE IMPROVED
FIRE-POLISHED GAUGE GLASSES
FOR
High-Pressure Steam Boilers.

8, VAUXHALL ROAD,
LIVERPOOL.

BEST FOUNDRY COKE.

Pease's West (Durham)	38s. per ton, delivered.

Special Quotations for Barge Loads.
Apply to J. T. KEENE, 455, New Oxford Street, W.C.

WHITTLE & SON'S
PATENT GAS-OIL LAMP,

For Lighting Towns, Railway Stations, Ironworks, Collieries Iron Mines, Ferry Landings, &c.

The Burner vapourises the Oil, converting it into Gas, at a cost of less than one farthing per hour, giving a light fully equal to coal-gas.

One supply of Gas Oil will burn about 45 hours, a cost of ninepence.

No Wick; no Chimney; no Trimming; no further attention after once lighting.

Contracts taken for Public Lighting.

It gives a clear and very brilliant light without smoke or smell, and is in use by several Railway Companies, Iron and Steel Works, and Collieries, &c., in this country and abroad.

It is also being adapted for Town Halls, Assembly Rooms, Churches, &c.

ADDRESS SOLE MAKERS—
WHITTLE AND SON, WHITEHAVEN.

SAM'S PATENT
DOUBLE-ACTION BOILER FEEDER,

Is much less costly than a Donkey Pump, and equally reliable.

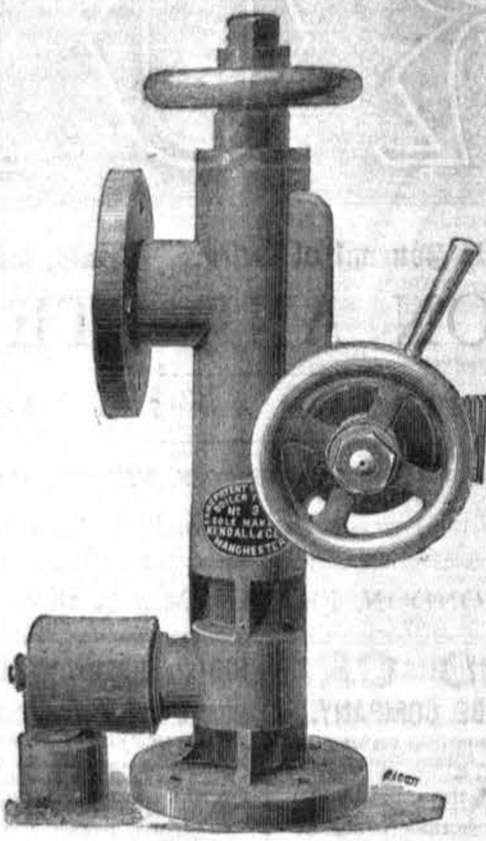
Will work with various variable stem pressure, and with water supply at a high temperature.

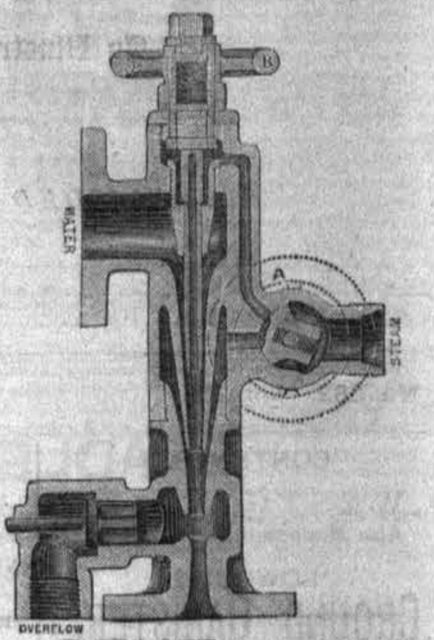
Admits of the feed being regulated according to requirements.

Has no stuffing boxes or joints entailing constant renewal of packings.

Can be examined internally throughout without removal or disconnection of a single joint.

So simple and easy to work that any unskilled person can put it in operation; indeed, in this respect, as well as certainty to continue in action without further attention until stopped, it is unequalled.





KENDALL AND GENT,

VICTORIA WORKS, SPRINGFIELD, SALFORD, MANCHESTER.

Applications for Agents for this useful and economical appliance will be gladly received, the names and addresses of good houses being advertised if desired. Agents for London and district, T. E. D. PLINN, 4, Queen Victoria Street. Agents for Sweden, E. ANDREW and Co., Gothenburg.

ESTABLISHED 1860
WHITTAM'S STANDARDS

MANUFACTURER OF EVERY KIND OF STEEL RULES.
STANDARDS, SQUARES, WHEEL SECTORS, &c.
25, ISLINGTON ST, SALFORD, MANCHESTER.

GOLD MEDAL, PARIS EXHIBITION, 1878.

THE HANCOCK INSPIRATOR

NEW COMBINED
PUMP AND INJECTOR.

Eclipses all other appliances hitherto introduced for feeding Steam Boilers.

Traction and Portable Engines are not perfect without them. It lifts its water 25 feet with a low steam pressure, and puts it directly into the Boiler. No adjustment necessary for varying steam-pressures.

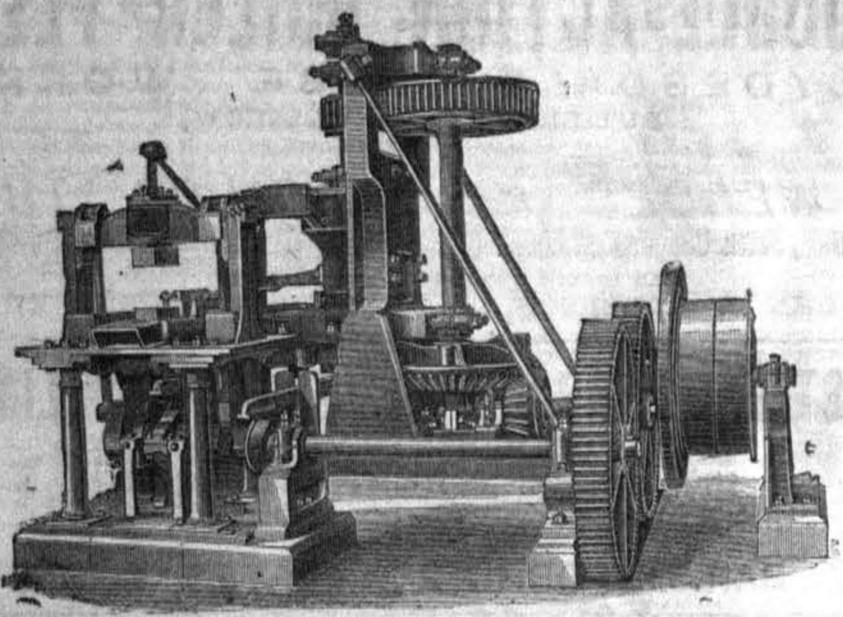
Invaluable on board large Steamers, Steam Launches, Tug Boats, &c.

No sudden jolt, nor the rolling and pitching of a vessel, will stop its action. As all other objectionable features in the ordinary form of Injectors are hereby overcome, it is an economical combination at once simple, and of guaranteed efficiency.

Full Particulars and Price Lists sent on application to the

HANCOCK INSPIRATOR COMPANY,
35, Queen Victoria Street, London, E.C.

CRAVEN'S PATENT BRICK MACHINE.



The above Machine, recently introduced, is the result of 30 years' experience in manufacturing Machinery of this class. By its action the clay is first pugged, then moulded under considerable pressure, and on delivery from the mould table the bricks are again powerfully pressed before removal, when they are ready for placing direct in the kiln, thus embracing all the advantages of the semi-dry making, and at the same time the quality produced is that of the best plastic made and pressed brick.

MANUFACTURED BY

BRADLEY AND CRAVEN,

WESTGATE COMMON FOUNDRY, WAKEFIELD.

Also Manufacturers of all kinds of BRICK and TILE-MAKING MACHINERY, CLAY MILLS, STEAM ENGINES and MINING MACHINERY.

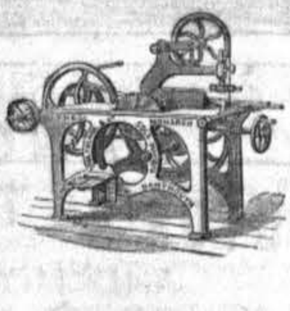
Sole Agent : H. CHAMBERLAIN, BRICK WORKS, BARNSLEY.

POLYBLANK & CO.,

SOUTH DEVON IRONWORKS, NEWTON ABBOT,

Manufacturers of

NEW PATENT PRIZE MEDAL



BAND SAWING MACHINERY.

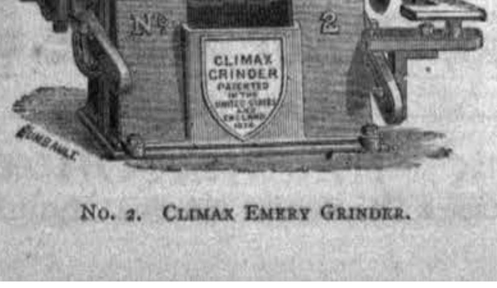
A. H. BATEMAN & CO.,

East Greenwich, London, S.E.,

Also at BIRMINGHAM and MANCHESTER.

ENGINEERS AND EMERY WHEEL MAKERS.

Ransome's Patent Emery Wheels
Emery Wheel Machines for Bench or otherwise
Tool Grinders
Saw Sharpeners
Long Knife Grinders
Pulley Grinders
&c.



No. 2. Climax Emery Grinder.

Cyclops Patent Forges and Fans. Blowers for hand or power
Sentinel Safety Valves
Lock-up Safety Valves
Water Gauges, Fusible Plugs
Metaline Bearings
&c.

R. S. NEWALL & Co.,

SOLE PATENTEES OF UNTWISTED WIRE ROPE

Beg to call attention to their superior made Iron and Steel WIRE Ropes, for Colliery and Railway purposes ; also for Capstans, Guide Ropes, Suspension Bridges, &c.

Ships' rigging supplied and fitted by experienced workmen to order, Pulleys made expressly for their Ropes. Patent Springs for ditto. Fencing Strand, Lightning Conductors, &c.

Manufactory .... Gateshead-on-Tyne.
London .... 130, Strand.
Glasgow .... 68, Anderston Quay.
Liverpool .... 36, Waterloo-road.

S. E. NORRIS & CO.,

56, 57, 58, SHADWELL, LONDON, E.

Manufacturers of

LEATHER MACHINE BANDS.

Endless Bands for Portable Engines.

WIRE-SEWN BELTING

Helvetia Leather Belting and Leather Delivery and Suction Hose, for Fire Engines and Ships use; Pumps and Hydraulic Leather.

MILL BAND & HOSE PIPE BUTTS.

Indiarubber Hose, &c.

HUNT & TAWELL

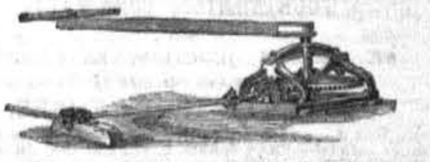
ATLAS WORKS,

EARLS COLNE, ESSEX,

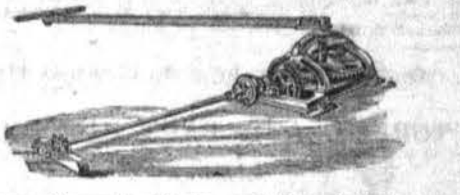
Manufacturers of

AGRICULTURAL IMPLEMENTS

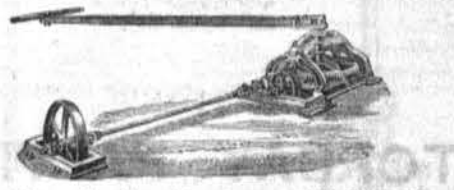
Including



Pony Gears for Churns and Elevators.



Horse Gears for Chain and Barrel Pumps.



Horse Gears for Saw Benches and Cotton Gins.

Horse Gears for Thrashing Machines Chaff Cutters, &c.,

And fitted or 1, 2, 3, or 4 horses.

Sole Manufacturers of BIDDELL'S PATENT FOOD PREPARING MACHINERY, recently manufactured by Messrs. Ransomes of Ipswich.

Prices and terms to Shippers, with cost of packing, quoted on application.

JOSEPH GILLOTT'S
STEEL PENS.

Sold by all Dealers throughout the World.

HICKMAN & CLIVE
BIRMINGHAM.
COFFIN FURNITURE
FOR THE WORLD'S MARKETS.

MOORE & MANBY.

DUDLEY.

London Offices:
BILLITER SQ., FENCHURCH ST., C.E.

Contractors to Her Majesty's Government *and the Council of State for India.*

REGISTERED TRADE MARKS.

M-M — SAXON

All Descriptions of Manufactured Iron of best qualities, viz., Bars, Hoops, Sheets, Boiler and Ship-plates, Angle, Tee, Bulb, and Beam Iron, Nail Rods, Fencing and Telegraph Wire, Rails and Railway Materials of all kinds, Pig-iron, Tin-plates, &c., &c., &c.

BICKFORD'S PATENT SAFETY FUSE

For Conveying Fire to the Charge in Blasting Rocks, &c.,

Obtained the PRIZE MEDALS at the "ROYAL EXHIBITION" of 1851; at the "INTERNATIONAL EXHIBITIONS" of 1862 & 1874, in London; at the "IMPERIAL EXPOSITION," held in Paris, 1855; at the "INTERNATIONAL EXHIBITION," held in Dublin, 1865; at the "EXPOSITION UNIVERSELLE," held in Paris, 1867; at the "GREAT INDUSTRIAL EXHIBITION," Altona, in 1869; at the "EXPOSICION NACIONAL ARGENTINA" in Cordova, S. America, in 1872, and (TWO MEDALS) at the "UNIVERSAL EXHIBITION" in Vienna, 1873, &c.

BICKFORD, SMITH & CO.,

TUCKINGMILL, CORNWALL,
AND
ST. HELEN'S JUNCTION, LANCASHIRE

MANUFACTURERS AND ORIGINAL PATENTEES OF

PATENT SAFETY FUSES,

Having been informed that the name of their firm has been attached to Fuses not of their manufacture, beg to call the attention of the Trade and Public to the following announcement:—

Every Coil of Fuse manufactured by Bickford, Smith & Co. has **Two Separate Threads** passing through the Column of Gunpowder, and they claim such **Two Separate Threads** as exclusively their Trade Mark.

MEMORANDUM FOR GAS COMPANIES.

TORBAY AND DART PAINT CO.
(LIMITED).

Sole Proprietors and Manufacturers of

WOLSTON'S

TORBAY PAINTS.

Offices—23, Great George Street, Westminster, London, S.W.

Works — Dartmouth and Brixham, Devon.

TRADE MARK.

These celebrated Paints are now very generally acknowledged to be the best and most economical in use. Gas Companies especially have, by experience, proved that no others so fully meet their peculiar requirements, as they are not only unaffected by great heat and effectually resist Sulphuretted Hydrogen, Ammonia, &c., &c., but they may be applied to Gasholders that have hitherto been covered with the unsightly coal tar. They are also cheaper than other paints and compositions; two coats of genuine Wolston's Torbay Paint being equal in covering power to three of lead paint, or any of the numerous low-priced spurious oxides that are now in the market, whilst the durability of Wolston's is unrivalled.

The colours most approved for Gasholders, Purifiers, Scrubbers, and all the plant and machinery used in and about Gas-Works, are—

For Dark Tints.

No.	per Cwt.	No.	per Cwt.
13. Torbay Red	34s.	8. Bronze Green	36s.
6. Dart Brown	34s.	16. Torbay Chocolate...	34s.
10. Carriage Red... ...	34s.	4. Brixham Black ...	32s.
1. Torbay Brown ...	30s.		

For Light Tints.

No.	per Cwt.	No.	per Cwt.
7. Imperial Stone ...	34s.	19. Light Stone	36s.
29. Portlane Stone ...	38s.	30. Bath Stone	38s.
31. Gray Stone	38s.	38. Buff	35s.

These *Prices* are for Paints in paste, carriage paid to any Gas-works in Great Britain, in consignments of not less than 5 cwt.; but all the above colours may be had, ready mixed for the brush, in various-sized paint cans with handles at a uniform price of 56s. per cwt. (6d. per lb.) carriage paid as above, in consignments of not less than 2 cwt., the sizes being 3 lb., 7 lb., 14 lb., and 28 lb. By taking the Paints in this convenient form, a considerable saving is effected in time, &c., as they can be immediately applied by any workman without the intervention of skilled painters to mix and prepare them; besides which all waste is avoided, and they may always be relied on as containing no adulterating or inferior material.

Where light colours are preferred, the works should be primed with two coats of No. 7, and finished with either of the other stone colours; and when the dark colours are selected, a priming coat of No. 13 is recommended.

Specimen Cards forwarded and Inquiries attended to on application to

23, GREAT GEORGE STREET, WESTMINSTER, LONDON.

ESTABLISHED 1832.

JAMES EADIE AND SONS,

(Formerly EADIE and SPENCER),

CLYDESDALE TUBE WORKS,

RUTHERGLEN, near GLASGOW,

MANUFACTURERS OF

LAP-WELDED IRON BOILER TUBES,

Iron Tubes, with Copper Ends brazed on, specially adapted for Locomotive Boilers.

SOLE AGENTS FOR LONDON AND DISTRICT:
JOHN C. ANDERSON, 114, FENCHURCH STREET, E.C.

THE STEEL COMPANY OF SCOTLAND, LIMITED,

(SIEMENS' PROCESS),
150, HOPE STREET, GLASGOW,

MANUFACTURERS OF

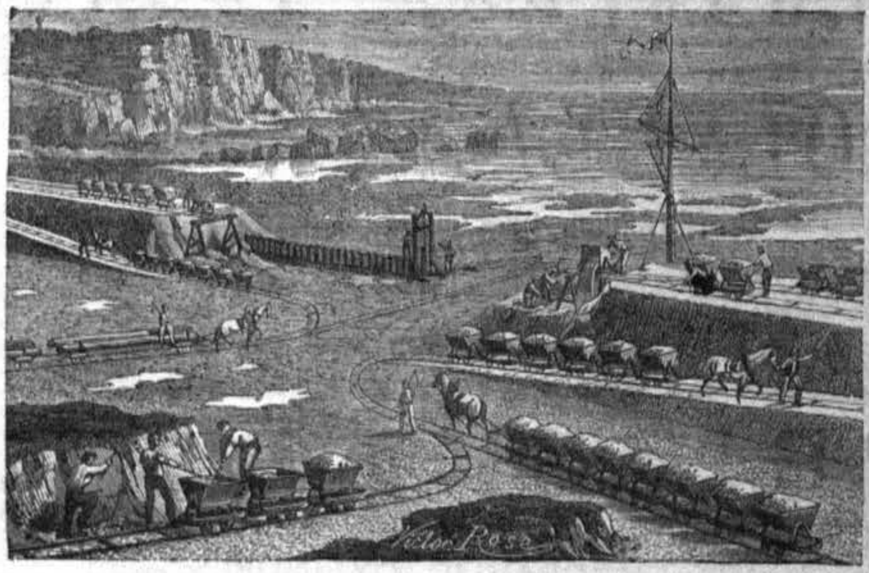
STEEL RAILS, FORGINGS, PLATES & CASTINGS.

950 CUSTOMERS IN FOUR YEARS.

DECAUVILLE'S PATENT PORTABLE RAILWAY.

20 Gold Medals and all the First Prizes in 1876, 1877, 1878, and 1879.
Royal Agricultural Society of Ireland at Galway. First Class Silver Medal.

GOLD MEDAL AND LEGION D'HONNEUR—PARIS, 1878.



MANUFACTURED AND SOLD BY
DECAUVILLE AINE, at PETIT-BOURG (SEINE-ET-OISE), FRANCE.
Private Telegraph Office.—Illustrated Catalogues in English, German or Spanish, Free on Application

PROCTOR'S MECHANICAL STOKER

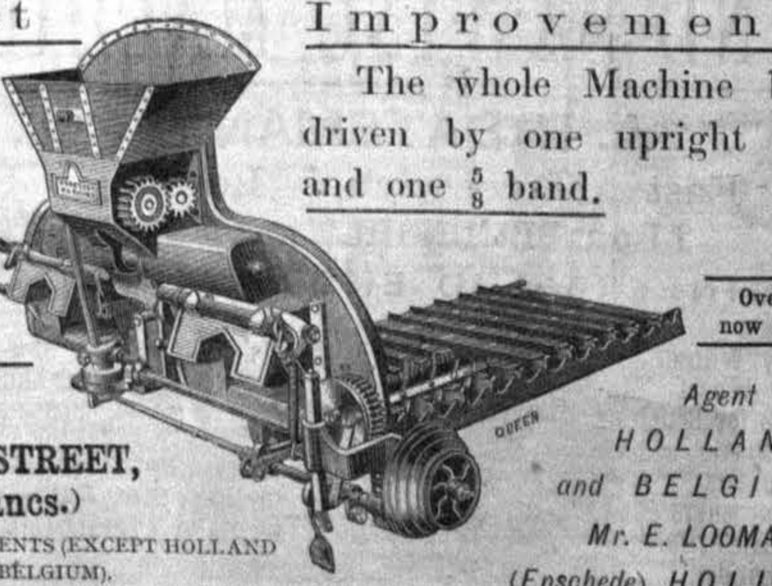
AND MOVEABLE FIRE BARS.

Great Improvements.

The whole Machine being driven by one upright shaft and one $\frac{5}{8}$ band.

One half of the whole working parts dispensed with.

Over 500 now in use.



Address

ALBION STREET,
Burnley (Lancs.)

CONTINENTAL AGENTS (EXCEPT HOLLAND and BELGIUM),
Messrs. ADERS, PREYER & Co., Manchester.

Agent for
HOLLAND
and BELGIUM,
Mr. E. LOOMAN
(Enschede) HOLLAND.

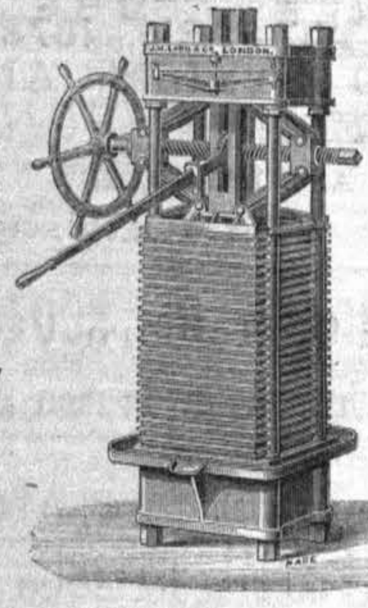
"BOOMER" PRESS.

Over 6000 Sold.

ADOPTED BY
H.M.
GOVERNMENT.

Can be Worked by Hand to a Pressure of 300 Tons, and by Power to 600 Tons and Upwards.

THE
STANDARD OIL COMPANY
OF NEW YORK HAVE
150
"BOOMER" PRESSES
IN
USE AT THEIR WORKS.



SPECIALLY DESIGNED PRESSES FOR

SEED, NUT, & FISH OILS LARD, TALLOW, TANK REFUSE, CIDER, WINE, &c., &c.

Also BALING PRESSES for Wool, Cloth, Tobacco, Hides, Rags, Esparto, &c.

ESTIMATES FURNISHED
FOR
SEED OIL PLANT.

JOHN H. LADD & CO., 116, QUEEN VICTORIA STREET, LONDON.

PHOSPHOR BRONZE.

(BY ROYAL LETTERS PATENT.)

THE BEST METAL FOR

BEARINGS, SLIDE VALVES, PUMPS, STEAM FITTINGS, &c

SUPPLIED IN INGOTS OR CASTINGS, WIRE, SHEETS, RODS, &c.

For Ingot Quotations, see Price List of Metals in this Paper

Sole Manufacturers,

THE PHOSPHOR BRONZE COMPANY, LIMITED,
10, SUMNER STREET, SOUTHWARK, LONDON, S.E.

FORSYTH, MILLER, AND CO.,

BROAD STREET, MILE END, GLASGOW.

Improved Malleable Iron (or Steel) Castings.

HYDRAULIC CYLINDERS,

Spur Wheels and Pinions for Rolling Mills, and other Heavy Castings up to 6 Tons.

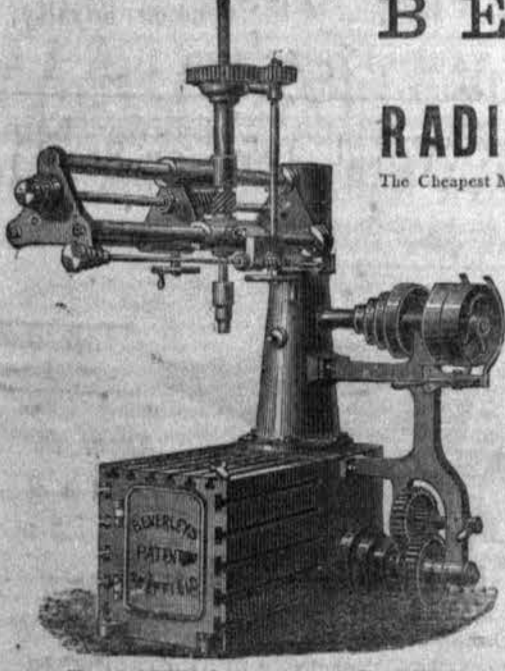
LONDON OFFICE :—
39, Tavistock Street, Covent Garden, W.C. GEORGE HATCH, Agent.
To which Small Patterns may be sent.

Agents for Sweden and Norway : Lander and Larrson, New Edmund Street, Birmingham. Agent for France : M. Tatin, 12, Rue de Malte, Paris.

BEVERLEY'S

Patent Self-Contained

RADIAL DRILLING MACHINE.



No. 1 SIZE' 8 feet 6 inch RADIUS.

The Cheapest Machine in the Market by 25 per cent. owing to the extreme simplicity of its construction obtained by this Patent.

PRICES AND PARTICULARS ON APPLICATION.

For further Particulars and Estimates, apply to

BEVERLEY & ATKINS,
"SPECIAL TOOL WORKS,"
STANLEY STREET, WICKER, SHEFFIELD.

MAKERS OF

Beverley's Patent Lathes, Improved Jaw Chucks, Slot Drilling Machines, Wall Drills, & every description of Machine tools.

AN INSPECTION INVITED.

SCHÄFFER & BUDENBERG'S

NEW INJECTOR.

This Injector possesses the following advantages :—

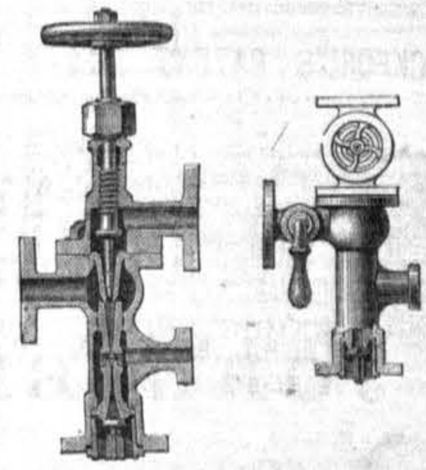
Great Simplicity,

CONSEQUENT DURABILITY,

NON-LIABILITY TO DERANGEMENT,

AND

CERTAINTY OF ACTION



PARTICULARS AND PRICES,

I, SOUTHGATE, MANCHESTER.

ASBESTOS.

WILLIAM HOLLYWOOD,

REGISTERED

NONE GENUINE WITHOUT THIS.

TRADE MARK.

15, MARGARET ST.
HIGH JOHN ST. GLASGOW.

Inventor and Sole Manufacturer of Asbestos Putty, for Steam and other Joints.

Asbestos Jointing Mill-Boards, in Sheets and Washers, any thickness.

All kinds of Crude and Manufactured Asbestos kept in Stock.

BARNARD AND LAKE,

AGRICULTURAL IMPLEMENT MAKERS,

RAYNE FOUNDRY,
BRAINTREE, ESSEX.

PATENT THATCH MAKING MACHINE.

MACHINE AT WORK.

Capable of producing 1500 *feet of Thatch per hour.*

METHOD OF APPLYING THATCH.

ALSO

PATENT HORSE HOES, ROOT GRATERS, TURNIP CUTTERS, PULPERS, &c.

THE HOWE WEIGHING MACHINES.

ADAPTED TO ALL STANDARDS.

For all Commercial, Manufacturing, Railway, Mining, and Household Uses, &c., &c., &c.

HIGHEST AWARDS AT PARIS, 1878.

OVER 600 SIZES AND STYLES, AND ALL GUARANTEED.

CATALOGUE ON APPLICATION IN ANY LANGUAGE.

FACTORY, RUTLAND, VERMONT, U.S.A.

J. FRED. DENNIS, General Manager, 8 & 9, Holborn Viaduct, London.

MEASURES BROTHERS & Co. Southwark St. London S.E.

Proprietors of Phillips' Patent Rights, and Manufacturers of Patent Girders, Rolled Iron Joists, Channel and Bulb Iron, Rivetted Girders, Flitch Plates, Chequered Plates, Columns, Tanks, Fire-proof Floors, Tee, Angle, Sash Iron, &c., &c.
Have always in their **TOWN STOCK** about **3,000 TONS** of the following sizes, from which orders can be immediately executed at low prices. Section Sheets and Book free on application.

ANGLES.		Manchester Office: 6 BOND STREET.					TEES.	CHANNELS.
8 × 4	3½ × 3½	3 × 3 = 10lbs.	5 × 3 = 13lbs.	7 × 2 = 14lbs.	9¼ × 3¾ = 24lbs.	12 × 5 = 42lbs.	5 × 6	12 × 3
6 × 6	3 × 3	3 × 1½ = 5 „	5 × 4½ = 23 „	7 × 3½ = 20 „	9½ × 4½ = 29 „	12 × 6 = 56 „	4 × 4½	9½ × 3½
6 × 3½	2½ × 2½	4 × 1½ = 7 „	6 × 2 = 11 „	8 × 4 = 22 „	10 × 4½ = 32 „	14 × 6 = 60 „	5 × 3	9¼ × 3¼
5 × 3½	2 × 2	4 × 3 = 12 „	6 × 3 = 16 „	8 × 5 = 29 „	10 × 5 = 36 „	16 × 6 = 62 „	3 × 3	8 × 3½
4 × 3	1½ × 1½	5 × 2 = 8 „	6 × 5 = 29 „	8 × 6 = 34 „	10 × 6 = 54 „	18 × 6½ = 82 „	2½ × 2½	6 × 2½
4 × 4	1 × 1					19½ × 7 = 100 „	2 × 2	4½ × 2½
							1½ × 1½	2½ × 1
							1 × 1	

JOISTS—Lengths, from 6 to 36 ft. PLATES—Width, 6" to 18"; Length, 12 to 30 ft.; Thickness, ¼" to 1".

PARIS EXHIBITION, 1878. GRAND PRIX, GOLD AND SILVER MEDALS AND HONOURABLE MENTION.

JOHN BROWN AND CO, LIMITED,

ATLAS WORKS, SHEFFIELD.

ARMOUR-PLATES, IRON AND STEEL PLATES, BEAMS, ANGLES.

PLATES FLANGED BY MACHINERY.

TYRES, AXLES, RAILS, STEEL PROPELLER BLADES, FORGINGS AND CASTINGS.

PATENT DEAD WEIGHT SAFETY VALVES. PAPER-CENTRE RAILWAY WHEELS.

SPRINGS, BUFFERS, FILES, &c.

BESSEMER, SIEMENS', CRUCIBLE AND ALL KINDS OF STEEL. FERRO-MANGANESE AND SPEIGELEISEN.

CHIEF OFFICES—SHEFFIELD. LONDON OFFICES—12, FENCHURCH STREET, E.C.

E. P. & W. BALDWIN, WILDEN WORKS, NEAR STOURPORT.

MANUFACTURERS OF

SHEET IRON. BRANDS— "BALDWIN-WILDEN" AND "SEVERN."

"EP&WB" WH

TIN PLATES. BRANDS— "WILDEN" "UNICORN" "ARLEY ♛" "STOUR."

STAMPING SHEETS, BUTTON IRON AND SHEET IRON, PICKLED, COLD ROLLED AND CLOSE ANNEALED.

CONTINENTAL AGENTS:—JOHN R. WHITLEY and CO., 8, Place Vendome, Paris.

CAMERON WARD & CO.,

MERCHANTS, ENGINEERS, CONTRACTORS, &c.

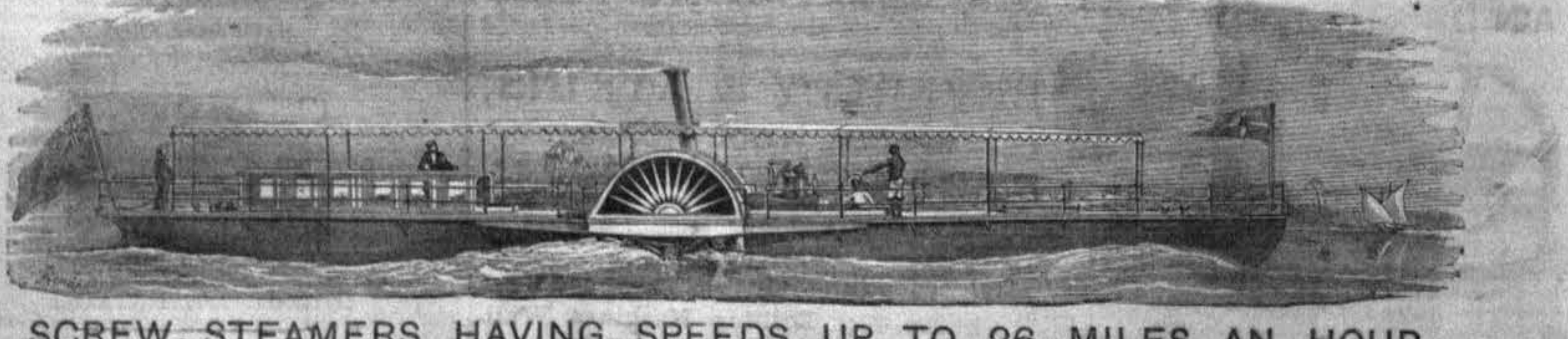
PALACE CHAMBERS, ST. STEPHEN'S, WESTMINSTER, LONDON.

C. W. & Co. beg to intimate they are prepared to treat for purchase of Patents or the working of the same on Royalty,

PATENTS OBTAINED AND MANUFACTURERS' DESIGNS AND TRADE MARKS REGISTERED

DRAWINGS, ANALYSES, &c., CAREFULLY PREPARED. PATTERNS AND MODELS MADE.

YARROW'S SMALL STEAMERS, YACHTS & LAUNCHES (Wood, Iron or Steel.)



SCREW STEAMERS HAVING SPEEDS UP TO 26 MILES AN HOUR.

PADDLE STEAMERS HAVING DRAUGHTS DOWN TO 6in. OF WATER.

MACHINERY CONSTRUCTED FOR BOATS BUILT ABROAD.

YARROW & CO. (late Yarrow & Hedley), Engineers & Shipbuilders, ISLE OF DOGS, POPLAR, LONDON.

THE SAVILE STREET FOUNDRY & ENGINEERING COMPANY, LTD., SHEFFIELD.

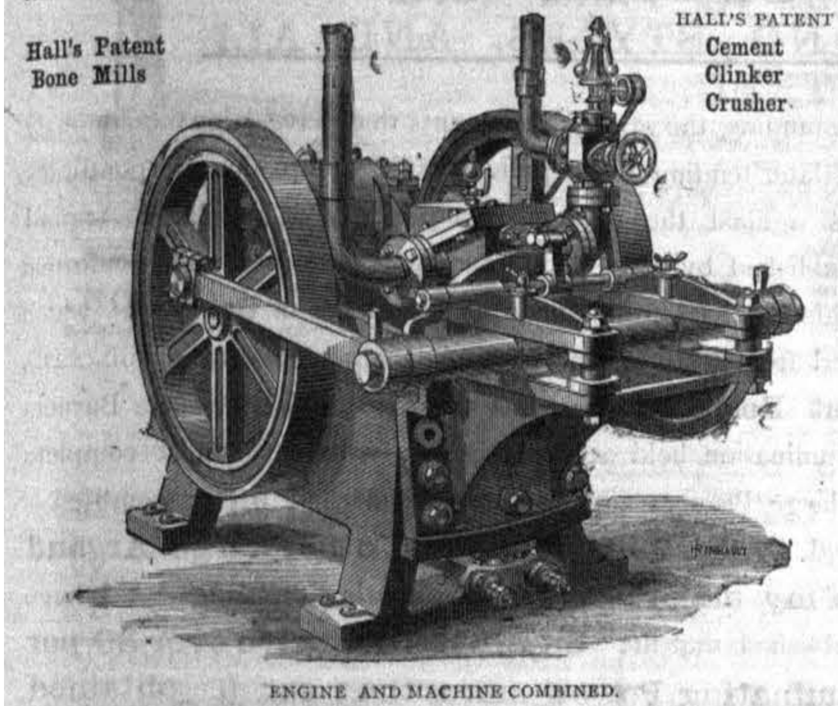
MAKERS OF

HALL'S PATENT DIFFERENTIAL GEARED BONE MILLS.

HALL'S MULTIPLE ACTION STONE-BREAKER AND ORE CRUSHER.

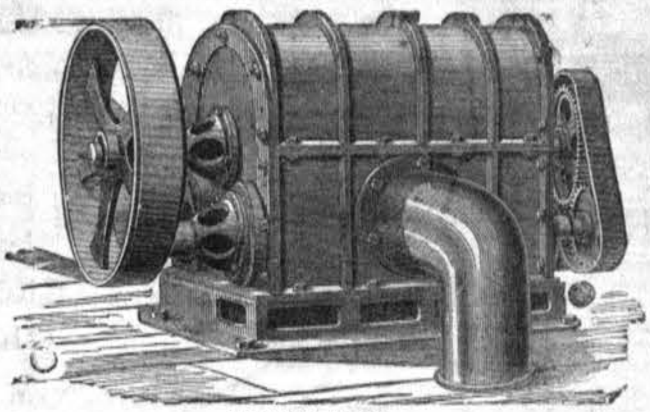
Hall's Patent Bone Mills

HALL'S PATENT Cement Clinker Crusher



ENGINE AND MACHINE COMBINED.

BAKER'S ROTARY PRESSURE BLOWER GAS EXHAUSTER and VENTILATOR, BAKER'S ROTARY PUMP, &c.



GENERAL VIEW.

This Blower is adapted for Cupolas, Smiths' Fires, Ore Hearths, Slag Hearths, Refineries, &c., &c., also for Ventilating Coal and other Mines, Ships, Buildings, Railway Tunnels, Drying Rooms, and generally for elevating Grain, Timber, Sugar, &c.

ITS ADVANTAGES ARE

Fewness of parts—Less pulsation than any of its class—Capability of running direct from an Engine—Not being affected internally by wearing of gears—Requiring no lubrication internally, and no dubbing to make it temporarily tight—Exhausting as well as blowing—Non-injury from dust—Steady running, without jerking belts—Unchangeability in power from damp—Blowing hot and cold equally well—Small power required for amount of air discharged—And entire absence of friction internally.

QUARRYING MACHINE.

Hand Power Rock Drill Company, Ltd.

FOR THE

LATEST TESTIMONIALS AND REPORTS OF PRACTICAL WORK

APPLY TO

T. B. JORDAN, SON AND MEIHE,

52, GRACECHURCH STREET, E.C.

IF PURCHASERS ARE UNABLE TO OBTAIN THE PRACTICAL RESULTS CLAIMED FOR THIS DRILL, J. S. & M. ARE WILLING TO UNDERTAKE CONTRACTS AT SAME PRICE PER FATHOM DRIVEN AS PAID FOR HAND LABOUR, AND, FAILING TO OBTAIN RAPID ADVANCE, AND TO PROVE THE ADVANTAGES OF THE MACHINE, AGREE TO TAKE IT BACK.

TUNNELLING MACHINE

JORDAN'S

PATENT "DEAD-BLOW" HAND POWER ROCK DRILL

Prices, Complete, £55 to £70.

PATENT GOLD-REDUCING MACHINERY AND GENERAL MINING PLANT.

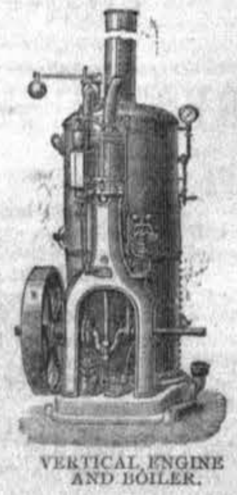
ALEXANDER SHANKS AND SON,

DENS IRONWORKS, ARBROATH,

AND 27, LEADENHALL STREET, LONDON.

TRADE MARK.

NEMO ME IMPUNE LACESSET



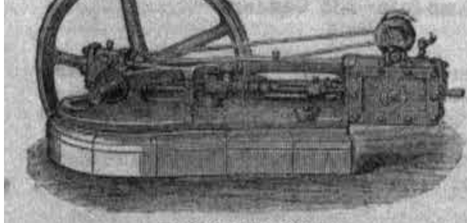
VERTICAL ENGINE AND BOILER.

SHANKS'S PATENT HORIZONTAL AND VERTICAL STEAM ENGINES,

STEAM CRANES, HOISTING ENGINES,

DECK WINCHES,

VERTICAL, CORNISH AND LANCASHIRE BOILERS.



THE CALEDONIAN.

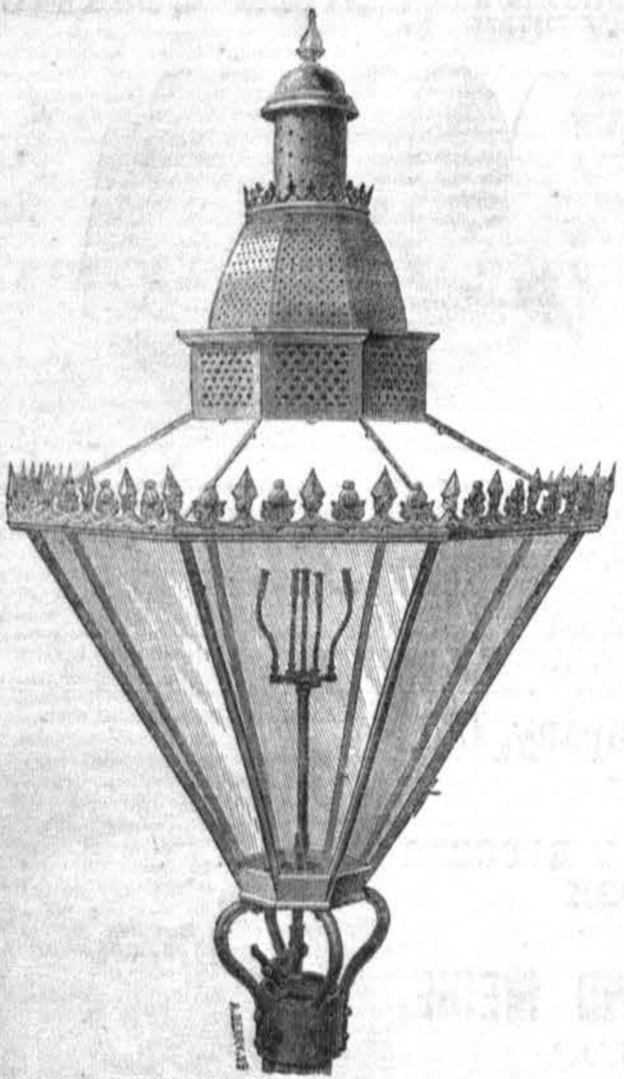
Horizontal and Vertical Engines and Boilers, Steam Cranes, Hoisting Engines, Deck Winches, &c., can be seen on application at 27, Leadenhall Street. Price List and full particulars sent free.

WHEATLEY KIRK, PRICE AND GOULTY, ENGINEERS, ALBERT SQUARE, MANCHESTER,

SOLE AGENTS FOR MANCHESTER AND DISTRICT.

WILLIAM SUGGS IMPROVED SYSTEM OF STREET LIGHTING,

SUITABLE FOR CANNEL GAS.



NEW WESTMINSTER PATTERN REFUGE LANTERN, with SUGG'S COMBINATION FLAT FLAME BURNER OF 200 CANDLE POWER.

Notwithstanding the various statements that have been assiduously circulated of late, tending to prejudice Public Companies, Corporations, and Vestries against the recognised superiority of my large Argand Burners (established by tests made by eminent scientists, and confirmed by testimonials received from numerous Engineers of Gas Works, which have appeared from time to time in the Advertisements of the JOURNAL), **the Highest Results** obtained at the recent trial for large Burners for Street Illumination held at Birmingham—where the most complete collection of large Burners and Lanterns extant had been assembled—were produced by the **200-candle and other large Argand Burners of my make**; clearly substantiating the statement I have repeatedly published, that the **"Sugg" Burners give over 30 per cent. Illuminating Power more than can be obtained from any other Burners with the like quantity and quality of Gas.**

It remains, moreover, to be mentioned that at the same trial my **Flat-Flame Burner,** with patent circular slit (patented 1875), produced the highest result in Illuminating Power of all the competitive Flat-Flame Burners present.

WILLIAM SUGG'S IMPROVED SYSTEM OF STREET LIGHTING,

EXTRACT FROM THE JOURNAL OF GAS LIGHTING, &c., MARCH 16TH, 1880.

Experiments in Improved Street Lighting at Birmingham.

PUBLIC TRIAL, WEDNESDAY, MARCH 10, 1880.

After a prolonged inspection of the various lanterns and burners, tests were made by a shadow meter between Sugg's 200-candle Argand (No. 9), Bray's 200-candle Quadruple Batswing (No. 10), and the Burner and Lantern as used by the Paris Gas Company in the Rue du Quatre Septembre (No. 12), with the results as shown in diagram, Fig. 2. These appear to agree pretty nearly with the photometrical results obtained from each burner, as shown in the preceding table (Mr. Hunt's Experiments, see page 404 of *Journal of Gas Lighting*, March, 1880).

PHOTOMETRICAL TRIALS.

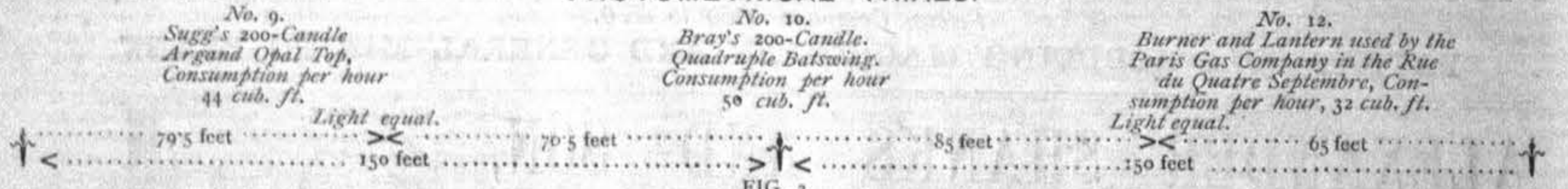

No. 9. Sugg's 200-Candle Argand Opal Top, Consumption per hour 44 cub. ft.
No. 10. Bray's 200-Candle. Quadruple Batswing. Consumption per hour 50 cub. ft.
No. 12. Burner and Lantern used by the Paris Gas Company in the Rue du Quatre Septembre, Consumption per hour, 32 cub. ft.
Light equal.
Light equal.
79·5 feet
70·5 feet
85 feet
65 feet
150 feet
150 feet

FIG. 2.

NOTE.—The Lights were fixed on Posts in the manner they are used in the Public Streets.

THE RESULTS WORK OUT AS FOLLOWS:—

No. 9.
27 per cent. better than No. 10.
= 191·7 Candles.
Add 24 Candles for the extra 6 ft. of gas required to equal the consumption of No. 10.

No. 10.
= 151 Candles.
or 8 per Cent. better than No. 12.

No 12
= 92·8 Candles.
If the consumption had been 50 ft. the Illuminating power would have been at the same rate—138 Candles.

Total 215·7 Candles or 42 per cent. better than No. 10 for the same quantity of Gas.

The next best on the List is Sugg's 100-candle Argand Burner, as fixed on the Refuges, in the districts of the Phœnix Gas Company, London Gas Company, Commercial Gas and Gas Light and Coke Company. They have been, moreover, definitely adopted by the Vestries of Lambeth, St. George's, St. Mary's, Rotherhithe, Lewisham Board of Works, St. Giles Board of Works, as well as the Great Eastern, Great Northern, London, Brighton and South-Coast and Metropolitan Railways.

The fact that over 1200 of these large Burners and Lanterns have been supplied to almost every Gas Company or Municipal Authorities in England alone, within a very short time, speaks significantly of the excellence of this system and the real merits it has been proved to possess.

Amongst other places the Burners and Lanterns have been adopted, are the following cities :—

NEWRY, PETERBOROUGH
LEEDS
SCARBOROUGH
EASTBOURNE
DURHAM
CHESTERFIELD
CORK
NOTTINGHAM
LEICESTER
STOKE-UPON-TRENT.
RAMSGATE
BLACKBURN
GREENOCK
LIVERPOOL
DONCASTER
LONDONDERRY
SHEFFIELD
BELFAST
OLDHAM
GLASGOW
DUBLIN
HASTINGS
SUNDERLAND
ROCHDALE
SOUTH SHIELDS
IPSWICH
BRIGHTON
COLCHESTER
GREAT GRIMSBY
SWANSEA
CARDIFF
WEST HARTLEPOOL
SOUTHAMPTON
PORTSMOUTH
LEITH
PAISLEY
PERTH
WIGAN
READING
SALFORD
MANCHESTER
BIRMINGHAM

Buenos Ayres, Monte Video, Hong Kong, Singapore, New York, Philadelphia, San Francisco, Milwaukee, Quebec, Ontario, Ottawa, Boston, Sydney, Melbourne, Port Adelaide, Berlin, Vienna, Cologne, The Hague, Amsterdam, Rotterdam, Brussels, &c., &c.

IRON.

LONDON, FRIDAY, MAY 7, 1880.

THE IRON AND STEEL INSTITUTE.

THE annual General Meeting of the Iron and Steel Institute is again being held in the rooms of the Institution of Civil Engineers, in Westminster, by permission of the President and Council of that body. The proceedings commenced on Wednesday morning, the chair being occupied by the President, Mr. Edward Williams. The first business was the presentation by the Council of their report for 1879 from which document it appears that during the past year eighty-three additional members were elected. Allowing for withdrawals and deaths the nett effective increase during the year is twenty-two members. At the present meeting seventy-five members were elected, being the largest decrease at any single meeting except two, viz., at the Glasgow meeting in 1872, when the increase was eighty members, and the London meeting in 1875, when eighty-four new members were added to the list. With the addition now made the membership of the Institute is brought up to 1026. M. Julian Deby having resigned the foreign secretaryship of the Institute, the Council have now under consideration the question of how the appointment should be filled up. The Council, acting in concert with the Committee appointed by the German Iron and Steel Trades, have decided that the autumn meeting at Dusseldorf shall take place from the 25th to the 29th of August next. The routine business having been concluded,

The President said he had the satisfaction of announcing that the Council of the Institute had awarded the Bessemer Medal to Sir Joseph Whitworth. It would be needless occupation of time to recount to such an audience as he saw before him the highly-distinguished services of Sir Joseph during his long and honorable career. It was scarcely too much to say that from him was learnt not only the desirability of accuracy in their engineering works, but the mode of arriving at and testing that accuracy in the special business of iron and steel manufacture. He was, as they knew, very eminent, and he (the President) did not doubt that the decision of the Council would have their hearty and unanimous approval. It unfortunately happened that Sir Joseph was absent on account of ill-health, and with their permission he (the President) proposed to wait upon him and present to him the medal on behalf of the Institute. It might not be out of place to formally record the fact that since their last meeting one of their members (of whom it might, he thought, be truly said that his name stood first in connection with steel, and would be associated with the manufacture of that metal for ever) had received some public acknowledgment of his merits. (He referred to Sir Henry Bessemer.) Considering the enormous advantage conferred by his inventions upon the world in general and upon the Realm of England especially, it could not be thought that the compliment paid to him had come too soon or that it was excessive in amount. It was, however, gratifying that there had been some national recognition of one who might be deemed the chief of their great iron metallurgy, and although, as compared with titles often bestowed, that conferred upon him might appear slight, it had at least the great merit of retaining the honourable name of Bessemer.

The President then went on to observe that when he had the honour of addressing them from that chair a year ago the belief was pretty general amongst them that the old familiar material which they called "iron" was, if not passing away, at least in a feeble condition, and unlikely to become strong again; and that steel, which had up to that time much increased in amount, was advancing enormously, mainly by reason of the addition of a basic lining in the converter. The firm of Bolckow, Vaughan and Co. had satified themselves that the new system was satisfactory, and were energetically working it when they last met. Not only in this country but on the Continent of Europe and in America also there was intense interest being manifested in the matter, and there was a pretty general prognostication that a great difficulty had been surmounted, and that ingot metal had become practically supreme. It must be feared, he observed, that those expectations had not hitherto been realised. At Eston there was at present no dephosphorising, and except at one establishment in Sheffield—as to which they were to have information—the same might, he thought, be said of the Kingdom in general. On the Continent a good deal was being done, and it was expected that success was not very far distant. They were glad to have at their meeting at least one very competent authority from whom they hoped to obtain accurate information as to the doings of their kin in America. He thought, however, he was correct in saying that there still remained difficulties of a somewhat formidable kind to overcome, and the great advantage that was looked for was still in the future. It was very far from correct to suppose that the able men who had the matter in hand were defeated or even seriously discouraged. On the contrary, at Eston, under the good guidance of Mr. Richards, special plant of a colossal character was being prepared for the process, the operations of last year having been conducted under very great disadvantages. Elsewhere new arrangements were being prepared; and when, in the coming autumn they met in Westphalia, in response to the hospitable invitation of the German ironmasters, they would hope to find their spirited efforts had been adequately rewarded. Those who, a year ago, were ready to bid farewell to iron of the ordinary sort were under a mistake. So far from diminishing rapidly its already reduced quantity, it had sprung up into unexpected and apparently vigorous life, and many forges and mills that were then desolate were again fully employed. As to the probable duration of the revival it would not profit them to speculate, and he was sure he could not give utterance to anything more universally agreeable to those present than to express the hope that the stimulus given already to iron and steel might long endure to the advantage and profit of all.

The first paper read was by Mr. Thomas Wrightson, "on Some Physical Changes occurring in Iron and Steel at High Temperatures." This was supplemental to a paper by Mr. Wrightson on the same subject, read at the previous meeting. The author first referred to a communication presented to the Royal Society in 1874, "On the Alleged Expansion in Volume of Various Substances in passing by Refrigeration from the state of Liquid Fusion to that of Solidification," by Mr. Robert Mallet. Having analysed Mr. Mallett's paper, Mr. Wrightson observed that underlying the whole of the communication was the assumption that dilatation was continuous from the solid to the liquid state, and as Mr. Mallet's experiment showed that the specific gravity of the liquid was lower than that of the solid, he concluded that the theory of buoyancy could not account for the floating of cast iron on molten iron. The whole mystery, however, disappeared if the expansion of solid iron could be shown to change to a contraction at the time the metal became liquid. The diagram produced by his (Mr. Wrightson's) instrument appeared satisfactory to show that reversal of the effect of heat, but in face of the opinion of so high an authority and so distinguished an observer as Mr. Mallet, he determined to make an experiment from the other end of the process, and to measure the successive changes in volume of a casting as it gradually cooled. A spherical mould was made of dried loam, the internal diameter when dried being 15·28 inches. The object of the experiment was to ascertain whether any measurable expansion occurred after a solid sphere was cast. As the ball could not be taken out for half an hour or more from the time of casting, arrangements were made to measure the change up to the time when it would be safe to move the ball. Having described those arrangements, Mr. Wrightson proceeded to state that the metal was a mixture of equal parts of No. 3 and No. 4 Foundry Cleveland iron. It was tapped into a one-ton ladle at 10.45 a.m. The successive changes were carefully noted, and it was found that from 10.53 to 11.17 there was an expansion of diameter equal to 1·985"—1·907" or ·078". Further measurements were taken until the ball was cool enough to be taken out of the mould, when the measurements were continued. It was shown that the liquid ball, in cooling, increased in diameter from 15·28 to 15·358 inches, or ·51 per cent. lineally, which is equivalent to an increase in volume of 1·53 per cent. Again, in contracting from its maximum volume to its cold state it decreased in diameter from 15·4 to 15·22 inches, or 1·17 per cent. lineally, which is equivalent to 3·51 per cent. in volume. Mr. Wrightson stated that, since the instrument with which he took the diagrams was exhibited at Liverpool, its construction had been modified with a view to reduce the friction. The name which has been given to the instrument is the "Oncosimeter," a measurer of increased bulk. The author then proceeded to place before the meeting the results of some experiments on balls of foundry iron immersed in fluid iron of the same quality, and to deal with the various hypotheses advanced respecting the physical changes in iron to which the paper had reference. He concluded by explaining the cause of welding in iron, the counterpart of that wonderful property being, he observed, in ice the interesting phenomenon of regelation.

Mr. I. Lowthian Bell said,—I propose chiefly to confine my observations to what has fallen from Mr. Wrightson with regard to the conduct of solid cast iron and liquid cast iron, but before I proceed I would mention that the observations made by him in his paper with regard to the conduct of a hoop of wrought iron being partially immersed in cold water is not altogether so new or so unexpected as he seems to imagine, because it is an ordinary way of contracting hoops, *i.e.*, in the event of the tire of a railway wheel being somewhat larger than required it is a common thing in all engineering establishments to place half the tire in water, which contracts the upper portion The tire is heated a second time, and the action reversed, and in this way by repeating the operation for time to time you can contract the hoop considerably.—Now, with regard to the apparent anomaly of cold cast iron floating in liquid iron. I have very little doubt if you were to ask two classes of men about it you would very probably—from those who have not considered the question—receive answers of a directly opposite character; the purely scientific man would doubt whether cold cast iron could float in liquid iron, and the practical ironfounder would tell you that it never sank. The fact is, as Mr. Wrightson has shown us very clearly, the truth lies somewhere between the two,—it does both; it sinks in the first instance and it floats afterwards; and, as I understand Mr. Wrightson, he wishes to infer that this power of flotation is entirely due to an alteration in the specific gravity of the cold iron. There is something more than that to account for the phenomena. No doubt it does sink in the first instance and it floats. Of course, as we all know, if you take a bar or any other form of cast iron and apply heat to it, it commences to expand, and it goes on expanding, so far as I am aware, as long as the iron is solid; but if on the other hand you begin with liquid iron you will find the converse take place; that is, you will not find the iron systematically contract in its fluid state, and I have endeavoured to measure this in a way somewhat different to that used by Mr. Wrightson but we both arrive pretty nearly at the same conclusion. I had an apparatus constructed like the diagram, which he explained together with his experiments upon the subject, and I am entitled therefore not only to infer that iron passing from the liquid to the solid state would be specifically lighter, and therefore floated easily on cast iron; but the iron, long before arriving at the temperature assigned by Mr. Wrightson, is also capable of being sustained and floated on the top of liquid cast iron. I incline to the belief that iron heated to something like 900 degrees is capable of floating on liquid cast iron. It may be said that iron at 900 degrees being specifically heavier than iron in its liquid state, how does it happen to float? I have calculated according to the data laid down by Dulong and others that the maximum cubical expansion experienced by cast iron in passing from the solid to the liquid state is something like 3 per cent., that is, about 1 per cent. lineal, and therefore it is something like 3 per cent. cubical. Calculated in the same way, Dulong makes out that at 900 degrees Fah. it would be about one per cent. Consequently I have to deal with something like the difference between one and three—that is 2 per cent. The fluid iron, being rather denser than iron, is at its maximum state of expansion. The real difference is only 9·0 per cent. It is a very small difference, therefore, that you have to account for. How does this arise? The 1·9 per cent. at all events has to be overcome. Now, there is one thing quite certain, fluids and fluid metals are no exception: they possess the power of "occluding," as it is called, gaseous matter. One of the most familiar instances I am aware of is that of silver. I think cast-iron possesses that property also, I do not say of absorbing oxygen gas alone, but we know that cast-iron and wrought-iron also is capable of absorbing gaseous matter. It is worthy of investigation whether the large quantity of gas given off for cast-iron in an ordinary mould may not be due to the occluded gas being given off from the cast-iron at the moment of consolidation, it is not, therefore, difficult to conceive that there is imprisoned and held fast upon the surface of this iron a sufficient quantity of gas to overcome the difference of the specific gravity. We have three circumstances in favour of this mass of iron-fluid; firstly, the expanion of iron due to its having been raised from a temperature of say 60 degrees up to 900. Secondly, a film of air or gas surrounding the iron; and thirdly, the possibility of another force. There is no doubt, when the cold iron is inserted in the liquid iron, that all the cast iron in immediate contact with it must be cooled, which means, of course, that that iron must commence to sink. The cooled iron cannot leave the surface of the solid iron without some warm iron taking its place, and in that way you may have a slight current of warm iron coming up and also assisting. I am not bound to say how the cold iron floats on the top; but I assert that iron does commence to float on the liquid cast iron at a period when it is specifically heavier than the liquid iron, and I think that I have proved that. It is a matter of very great interest no doubt, perhaps it has not an immediate practical bearing upon the operations of metallurgy; but undoubtedly every fact may have a remote value.

Dr. Siemens: I think we are indebted to Mr. Bell for having taken up the question experimentally, and to a certain extent affirmatively. Mr. Bell's experiment goes so far in confirmation of Mr. Wrightson's experiment, and against the hypothesis brought forward some years ago before the Royal Society, by Mr. Mallett, that there seems to be no doubt regarding the fact that cast-iron in setting expands, and only after it has set it follows the general law of solids in contracting according to the diminution of temperature of ordinary solids. That is in itself a very important fact. Mr. Bell might have added one other cause to those he mentioned. Why is a piece of partially-heated metal to rise to the surface much sooner than it could be expected to do, judging simply by the fact of its expansion by heat? Mr. Bell assigns part of the reason to the exclusion of gases on the surface, and no doubt it is a good reason, but it is a reason which would apply more forcibly to small pieces of metal than to large. Mr. Bell also brings forwards a cause which, to my mind, is not so apparent as the first—that the currents of hot fluid metal set up in the bath might tend to float the solid metal. I am afraid the current would act the other way. The effect of this solid being of a lesser temperature than the fluid metal would cause currents to flow downwards rather than upwards, and such currents would rather draw the solid downwards than upwards. There is one cause which Mr. Bell has not mentioned. In pushing the solid iron to the bottom of the fluid metal it not only begins to heat on the surface long before the interior is heated, but it expands on the surface, and this expansion will cause a tearing action upon the interior, tending to expend the interior iron. The amount of heat required on the surface to expand the interior, one per cent., is not beyond the limit of what we could expect. Iron expands for one degree Fah., 130 thousandths of its bulk, therefore it would expand one per cent. for an increase of temperature of 1300 degrees Fah. If, therefore, the external portion of the iron were to be expanded 1300 degrees more than the inside, this would account for the one per cent. increase of bulk of the metal in the interior, and would help us over the difference which still exists between Mr. Wrightson and Mr. Bell. But this difference is not such as to make us reject Mr. Wrightson's theory. As regards the cause there is nothing unnatural in assuming that metal will change at certain points its density, but such change of density will always be accompanied by a change of its physical condition in other respects—by a change of its specific heat. If we look round to other substances for guidance we have a very remarkable one in the metal selenium, which becomes less conductive when under a ray of light It is found that in cooling liquid selenium it suddenly at a certain point changes its bulk and its specific heat. In cooling the liquid, the thermometer will drop for every minute say one degree, until the critical point is reached, when, instead of continuing to drop, the thermometer actually rises, showing that at this point, where the selenium alters its conductivity, it suddenly parts with a great deal of latent heat; and I believe that cast iron, when it suddenly begins to expand, will be found to absorb a great deal of heat, a circumstance which would account for the greater bulk it occupied at that point. If an iron wire is heated to whiteness, and is allowed gradually to cool, after it has become almost black, it suddenly expands and lights up again, showing that there is a sudden evolution of heat produced which evolution could only be accounted for by a sudden departure out of the mass of iron of latent heat. It is probable that the changes referred to by Mr. Wrightson are the result of sudden changes of specific heat.

Mr. Stead said that having been present at Mr. Wrightson's experiments, he felt confident that his deductions and theories were well founded, and very correct. Mr. Bell had advanced a theory with reference to the gases passing off from metal, assisting it to rise. If cold metal rose when put into hot iron, and no gas was evolved, they would say that the hypotheses were untenable, and it was a thing very frequently seen; only the other day he saw a round ball of grey metal put into fluid iron, and no gas perceptible was given off. In the case of white iron it was different. It was very probable that the expansion in metal in setting was due to the separation of graphite. He then referred to well-known facts in regard to chemical action, which he thought justified the conclusion that if there was no separation of graphite there would not be any expansion, and that if they commenced with metal 6 per cent. denser than an ordinary metal they would never have a floating effect at all, *i.e.*, if white iron, which had a specific gravity of 7½ was about 8 per cent. heavier than grey iron it would sink to the bottom. He was not convinced that white iron did actually rise and actually float. He then tried the experiment and found that white iron took a very much longer time to rise to the surface than grey, but after it had arrived at the top it seemed to jut out quite as much as the grey, *i.e.*, showing the expansion was very much greater for white than for grey iron. The only explanation he could give for the difference in the expansion of the two metals was that the graphite slowly combined with the iron before it passed completely into the fluid state. If they accepted that hypothesis the whole matter became very simple. There was a contraction and expansion going on which neutralised each other—a physical expansion and a chemical contraction.

Sir John Alleyne said white iron contracted much more in cooling than grey iron. The piece of pig-iron before him had been full up to the points of the crescent, for it was almost a crescent. If that iron were to expand again in its own fluid iron to anything like the form it took when solid, there was an explanation why it should float.

Mr. Jeremiah Head said if he understood Mr. Wrightson's theory of regelation it was this:—when two pieces of ice are brought together at 32 degrees Fah. so that they were almost on the point of melting and the surface between the two were wet and also at the temperature of 32 degrees the molecules might be considered continuous, except that the water in between the two was in the form of water and on either side round it, it was in the form of ice. If therefore they could conceive taking away the latent heat in the water it became ice and the molecular continuity was at once secured. He understood Mr. Wrightson to contend that the same thing happened in regard to two pieces of iron brought together with their surfaces at welding heat. He had read what Tyndall and Helmholtz had to say about regelation but it certainly never struck him that regelation was welding nor that welding was regelation. But if Mr. Wrightson had succeeded in identifying those two properties he thought he had made a most interesting and valuable discovery, but that theory of his seemed to depend upon the fact that iron like water lowered its temperature under pressure, at all events within the range of certain limits. There were many other substances which would not weld such as copper and other metals. It would be interesting to know if those metals which would not weld, also refuse to lower their temperature when subjected to pressure. If molecular continuity was complete in the case of two pieces of ice regelated, the ice when subjected to tensile strain would be as strong at that regelated part as at any other and therefore if the analogy was complete, two pieces of iron welded together should be equally strong at the weld as at any other part; now, as far as he knew, welded iron was always a certain percentage weaker at the weld than at other parts.

Mr. E. A. Cowper said he did not go the whole length of Mr. Wrightson, but believed that two surfaces laid together would weld without any serious mechanical pressure being brought upon them. He thought the experiment as to the measurement of the ball was not intended as a quantitative experiment to show the exact specific gravity, but to show that there was an expansion after the liquid metal was put into the mould, and he thought the experiment a very good one and very useful as far as expansion went.

Mr. Snelus said that early experiments he had made at Dowlais bore out those which Mr. Wrightson had made, not only with iron, but with slag; and he thought it was a much more general law than had been supposed. With respect to welding he thought Mr. Wrightson had used the term "liquid" where he meant a plastic material. The experiments Mr. Wrightson had made would open up a new field for study, which would be extremely valuable, not only in iron metallurgy, but in other branches of science.

The President said that original investigations were in the highest degree valuable, and it was rarely that the result of such investigations came before them in such a clear and concise way as Mr. Wrightson had brought before them his results. The effect of rapidly cooling a bar of iron on one edge while the other remained hot was to put a great strain upon the edge that was not cooled, and so upset it a little. As to regelation, it seemed to him that between lumps of ice wet upon their surfaces and blocks of iron likewise wet upon their surfaces, there was a great difference. That which was fluid upon the surface of the ice was exactly of the composition of ice in every way, and there was nothing to prevent absolute rendering or combining of the two surfaces if they altered the conditions in the way mentioned by Mr. Wrightson, but the wrought-iron slabs were not wet with fluid iron, but with a layer of oxide of iron, which would interpose and prevent contact with the metallic surfaces. He did not think that any amount of pressure, or any amount of manipulation whatever, short of removing entirely the fluid oxide, and bringing together perfectly clean metal surfaces at a proper heat would weld two blocks of wrought-iron together. What they understood by welding was of course a matter that was essential to the whole argument. If by welding was meant the making of two pieces into one, he had come to the opinion that the thing was impossible. The surfaces were never clean, and any interposing foreign matter (which the oxide of iron was for the purposes of this argument) prevented welding where the surfaces of the pieces brought together were rough, as they almost always were, and the projections touched at the points, and there was to some extent metallic contact by those projections forcing their way through the cover of oxide. If he was correct then it seemed to him that Mr. Wrightson's theory of welding by regelation could not be maintained.

Mr. Wrightson in reply admitted Mr. Snelus' criticism as to the ambiguity or inapplicability of the word "liquid," though he had qualified it by saying that it was on the border line between liquidity and plasticity. The phenomenon of regelation was one which had puzzled many scientific men, and he entered at some length into its further explanation. The fact of the oxide of iron existing on the surface did not in his view entirely demolish the possibility of the theory of regelation being correct. Mr. Stead had paid a great deal of attention to the subject of expansion, and he (Mr. Wrightson) thought at one time he was going to prove that it was due to the separation of graphite, but after carefully considering the whole matter he appeared to adopt the view that it was physical expansion.

A paper was then read by Mr. R. Pink, of Hoerde, Westphalia, on "The Dephosphorisation of Iron in the Bessemer Converter." The author first observed that it having been demonstrated that the problem of dephosphorising iron in the Bessemer converter had, by the Thomas and Gilchrist system, been definitely solved at the works of Messrs. Bolckow, Vaughan and Co., the Hoerde Company, who had representatives at Middlesborough and Eston during those experiments, at once determined also to test the process. It was then thought that their plant was such as would make it comparatively easy for them to do this, and they commenced with a small plant. The revival of trade, however, had put such a pressure upon the whole of their plant as to interfere with the experiments so that the process had not had either the time or space allotted to it which was so necessary for its proper development. On the 22nd of last September at Hoerde there was rolled direct from the ingot the first rail manufactured under the Thomas patent in Germany. That rail stood exceedingly well under the tup, in spite of the phosphorus showing 12 per cent., but by the third charge the phosphorus was reduced to ·06 per cent., and from that period, with but one exception, no difficulty has been found in keeping the phosphorus within the limits of ·08 per cent. to ·04 per cent. The method of carrying out the process at Hoerde is as follows:—After heating up the converter, and without tipping out the coke used in so doing, the lime mixed with a little small coal is added, and, after blowing through for a few minutes, the metal is run in. In the three-ton converters the time occupied in blowing a charge of from 3 tons 7 cwt. to 4 tons, up to the vanishing point of the carbon lines of the spectrum, varies from nine to thirteen minutes, and the afterblow from 115 to 200 seconds. A test piece is taken shortly before the charge is considered as finished; this when forged is cooled in water and then broken, after which the blowing is continued as may be considered necessary. A second test piece is now rarely taken, as the first is so timed that a further half or three-quarter turn-up of the converter suffices to finish the charge. The slag is then run off and the spiegeleisen added. This running off of the slag prevents in a great measure the reduction of phosphorus out of the same by means of the fluid addition. Good sound burnt lime broken up to about the size of hens' eggs, and used as fresh as possible after burning, has been found to be the best basic addition; and could this be introduced cheaply and expeditiously in a white or red-hot state into the converters, it would prove of great advantage. The lining of the converters will be better protected during the oxidation of the silicon and a fluid slag earlier formed by this means. After giving the details of some of the charges and their results, Mr. Pink observed that an interesting and practical proof of the quality of the steel had been given during the last few days. The fire tube of a Cornish boiler at one of the mines in the neighbourhood of Dortmund had to be removed on account of two of the plates bulging-in. The water with which the boiler was fed contained such large quantities of common salt that an incrustation of several inches was formed in a very short space of time. Under the circumstances the plates got red-hot and buckled in. They showed no flaw, although the indentations were in some cases 4 feet long, from 6 to 18 inches wide, and 7 or eight inches deep. The plates were manufactured at Hoerde under the system of Messrs Thomas and Gilchrist in February of this year. In conclusion Mr. Pink observed that at the Rhenish Steel Works, in Ruhrort, the process was worked even more successfully than at Hoerde, and that the following German firms had arranged for working or were working under this system:—Messrs. De Wendel, Messrs. De Diedtrich, Gienauth Brothers, Stumm Brothers, the Lothringen Ironworks at Ars, on the Mosselle, the Barbach Ironworks, the Rothe Erde by Aachen, the Bochum Company, the Königen Marien Works in Saxony and others.

The discussion on Mr. Pink's paper was postponed until Thursday.

Mr. J. E. Stead then read a paper on an "Improved Apparatus for Analysing Blast-furnace and other Gases." After observing that little attention had hitherto been paid to the systematic analysis of waste gases, the author described the various apparatus in general use for that purpose, and pointed out their defects. He then proceeded to describe the improved form of apparatus, which consists of a measuring tube half an inch in diameter, and having its length divided into 270 mm. The upper part is joined to the horizontal tube, which is furnished on each side of the joint with stopcocks. The lower end is drawn out and thereby considerably contracted, so that a small one-eighth of an inch india-rubber tube can be readily slipped over it. Into the upper part of the measuring tube are fused two platinum wires for the passage of the electric spark. The whole length of the tube is surrounded by a glass cylinder closed at the lower end with an indiarubber cork, through which the contracting portion of the measuring tube passes. A tube parallel with the measuring tube is also surrounded by a water jacket, and is of the same dimensions as that surrounding the measuring tube. The upper end is open to the atmosphere, the lower part corresponding to the lower part of the measuring tube. The whole is separated by two strong frames of wood, and the small capillary tubes at the upper part are fixed firmly into the wood setting with electric cement, so that there is very little danger of breakage excepting great violence or carelessness is used in manipulating with it. The parallel tubes projecting from the lower parts of the two cylinders are brought into communication by means of a glass three-way tube, the third passage of which communicates with a mercury reservoir which slides between the parellel wood guides on each side of it. The left-hand arm of the capillary tube at the top of the endiometer is bent at right angles and communicates directly to the potas laboratory chamber, which contains a strong solution of potash. The adjusting level and cathetometer are secured on parallel brass rods immediately in front of the measuring tube. The author proceeded to describe the method adopted in taking a sample of gas from the blast-furnace and the process of working the apparatus and concluded by directing attention to the value which gas analysis, if properly applied, was likely to possess to those who were concerned in the working of blast-furnaces.

Mr. Snelus, Mr. Cowper, Mr. Rocholl, Mr. I. Lowthian Bell and Mr. Head having borne testimony to the value of the instrument for analysing gases, Mr. Stead replied, and the proceedings were adjourned to the following day.

THURSDAY.

On assembling yesterday morning, the first paper read was "On the Manufacture of Bessemer Steel and Ingot Iron from Phosphoric Pig," by Mr. C. B. Holland and Mr. A. Cooper, of Sheffield. The authors in the first place observed that steel had been defined as "an alloy of iron and carbon, which is capable of being cast whilst in a fluid state into a malleable ingot," and all other elements usually found in the steel of commerce, such as silicon, sulphur and phosphorus, might be regarded as impurities, and were more or less hurtful. In like manner, ingot iron might be defined as an iron capable of being cast whilst in a fluid state into a malleable ingot, and other elements found in it (including carbon) might also be regarded as impurities. It followed that those steels and ingot irons were the best and purest which contained the noxious elements in the least quantities. If it could be shown that steel and ingot iron could be produced from common pig of the same chemical composition, and capable of standing the same mechanical tests as that produced from the purer irons, one was as good as the other for all purposes. In November last year the authors went to the Hoerde Works in Westphalia, by invitation, to inspect the dephosphorisation process by the Thomas and Gilchrist process. The result was that it was introduced at the works in Sheffield with which the authors are connected After various experiments made to obviate the gathering of slag and metal at the nose of the converter, they eventually succeeded in overcoming the difficulty mainly by reducing the area of the opening. After successfully combating with several other difficulties which somewhat retarded the working they succeeded in obtaining excellent results. During the week ending April 10th, twelve test pieces, taken at random from the week's work, contained of phosphorus as follows:—

No. 1	·103 per ct.	No. 5	·065 per ct.	No. 9	·111 per ct.
,, 2	·067 ,,	,, 6	·074 ,,	,, 10	·054 ,,
,, 3	·040 ,,	,, 7	·073 ,,	,, 11	·074 ,,
,, 4	·051 ,,	,, 8	·052 ,,	,, 12	·048 ,,

And in the week ending April 17th, when not a single sample was taken during the operation, the average amount of phosphorus contained in thirty-six blows, all of which were analysed, was ·056 per cent., the highest being ·101 per cent., and the lowest ·019 per cent. The composition of this quality of steel has been in other respects very regular.

A paper was then read by Mr. Arthur Willis, of Swansea, on "Reactions in the Open-hearth Furnace." The author observed that steel from the open-hearth furnaces, could be produced either from—1st, a mixture of pig-iron and scrap; 2nd, pig-iron and ore without any scrap; or 3rd, pig-iron, scrap, and iron ore. All those methods could be employed with advantage, but the most usual was the third, because it utilised all scrap produced during the different stages of manufacture. In the Bessemer process carbon, silicon and manganese appeared to be eliminated uniformly. In the open-hearth process the degree and the time of elimination were quite different. During the time the charge was passing into the fluid state, carbon, silicon and manganese were all more or less oxidised, about 50 per cent. of the total amount contained in the charge, varying slightly with the temperature of the furnace. As soon as the whole of the charge was fluid, the carbon remained almost if not entirely stationary, until the whole of the silicon and manganese were oxidised, which process took from three to four hours. During the time occupied by the oxidation of the silicon and the manganese—no gas being given off—the metal in the bath remained tranquil. When the silicon was reduced to about 0·02 per cent., and the manganese had disappeared entirely, the oxidation of the carbon commenced, and the evolution of carbonic oxide threw the metal into violent ebullition, described by the melters as "being on the boil." The ebullition continued more or less until the carbon was reduced to 0·10 per cent. or under, when the metal became perfectly quiet, and the slag, which half-an-hour previously had been of a brownish tinge, began to blacken from a slight oxidation of the metal. The author then gave the results of analyses referring to the oxidation of carbon, silicon and manganese, during the different periods of the process. He then observed that when pure ore was used, no appreciable alteration took place in the percentage of sulphur and phosphorus contained in the pig and scrap, but it was necessary to employ only the purest. The pig-iron most suitable for the open-hearth process—the sulphur and phosphorus being low—was that containing the least carbon and silicon.

The last paper for the day was by Mr. Henry Simon, of Manchester, on "An Improved System for the Utilisation of Bye-products in the Manufacture of Coke." The author commenced by observing that it seemed strange that in the manufacture of coke for metallurgical purposes the tar and ammoniacal liquor should until now, in almost all cases, be allowed to go to waste and thus at the same time to increase the nuisance which coke ovens generally were to the neighbourhood. He then referred to the old method of coke manufacture, and noticed the various improvements which had been introduced from time to time. In the new system, which he next described, the coal is rapidly carbonised by subjecting a comparatively thin layer of it to a high temperature in a closed and retort-like vessel, and the volatile products are burned around the outside of this vessel, and only after they are deprived of the tar and ammoniacal liquor. Each oven is a long, high narrow chamber of brickwork, and a number of these are built side by side, with partition walls between them sufficiently thick to contain horizontal flues. Flues are also formed under the floor of each oven, and at one end of these is a small fireplace, consisting of a firegrate and ashpit with door, the fire door having fitted above it a nozzle, through which gas produced from the coking is admitted, to form a flame over some fuel burning on the grate. Only a trifling amount of such fuel, consisting exclusively of the small refuse coke, is used here, its function being more that of igniting the gas than that of giving off heat. The Terrenoire Company introduced a modification of this process in 1867, and had since then, from time to time, increased the number of ovens at their different works, the results being in all respects satisfactory.

At the close of the discussion on Mr. Simon's paper, the meeting was adjourned until this (Friday) morning.

DISCUSSION.

In opening the discussion, Mr. Snelus said there can be no reasonable doubt that the basis dephosphorising process is an assured success, both practically and commercially. It is very gratifying to me after the strong assertion that I made in this room last year to find that the papers read confirm the views I then expressed in every particular. I think it will now be admitted that not only phosphorus but sulphur also can be eliminated by performing the Bessemer operation in a basic-lined vessel, and that this can be done regularly, and with as much reliability as the removal of carbon and silicon in an acid or ganister-lined vessel, phosphorus and sulphur requiring only a sufficiently strong base to fix them when removed from the iron. It thus appears that there is quite sufficient mechanical action during the process to ensure the thorough contact of the basic slag and the metal, and the fears expressed last year were needless. Neither is it necessary, as M. Pourcel assumed, that in order that dephosphorised iron should be good malleable metal that a large excess of manganese should be added at the end of the blow, for Messrs. Holland and Cooper cite several instances where no spiegel whatever was added, and the metal was thoroughly workable. Still less is it necessary to have an excess of silicon. Indeed, as I have always held, the very reverse is the case, and the less silicon present the better. Neither is there the waste of iron during what has been termed the "after blow" that some persons feared. Also from the analysis of slags quoted by Mr. Pink it will be seen that there is also absolutely less iron in the slags than is usual in the ordinary process, and the quantity is very far from sufficient to carry off the phosphoric acid present. I think that these analyses prove conclusively that the phosphorus goes off combined with lime. I contended last year that it was most important to keep the silica and alumina low, and I am glad to see that not only is the silica being gradually reduced. but that the alumina seems to be altogether absent, Nothing had been said on the possibility of making the finest classes of steel for cutlery purposes by this process. Now, after very careful investigation some years ago, I have come to the conclusion that the essential for a steel to carry a keen cutting-edge without being brittle, is that it shall not only be free from silicon and carbon, the right proportion of carbon, but that it shall also be almost absolutely free from phosphorus. I believe the extremely small amount of ·02 per cent. phosphorous, two in ten thousand. is enough to constitute the difference between a good cutlery steel and an inferior one. If this is so it is clear that the basic dephosphorising process is capable of affording metal even from inferior pig eminently suitable for conversion into this high-class steel. This is a point of great importance. The samples of metal on the table and the tests recorded in the papers, show that were softness and ductility are required, dephosphorised metal cannot be so called, and I think the reason of this is obvious, viz., that before the phosphorus is removed almost the last trace of silicon must of necessity be removed; while for some reason, not yet explained by any writer, the metal blown in basic-lined vessel does not absorb oxygen as it does in an acid lined vessel, and therefore does not require the addition of manganese and carbon to make it workable. I would venture to suggest that the reason for this is that the oxide of iron usually formed at the end of the blow, and which is then disseminated through the mass of iron-making it red-short, is when a basic slag is present dissolved out of the he bath as ferrate of lime, thus leaving the metal free, and therefore not red short. With regard to the simplicity of the operations as now conducted, I may be allowed to corroborate the remarks by Messrs. Holland and Cooper that there is no difficulty in completing the blow without taking a sample until the metal is being poured into moulds and the simple expedient of pouring out the bulk of the slag before the spiegel is added gets over a difficulty that created a strong impression this time last year. With regard to the difficulties of turning out such large makes as we are now accustomed to do with hematite, I think it should be borne in mind that even 540 tons in a week out of a pair of vessels would have, a few years ago have been deemed incredible with the ordinary process; indeed, when in America in 1872 I made a special journey of over 1000 miles simply to see the Harrisburg Works, which at that time was reported to be making 500 tons of ingots per week out of a pair of vessels, as this output was then so far above our English practice that I could not believe it without verifying the fact with my own senses. Some years ago, when I explained the amount of success I had obtained in removing to an eminent engineer, and told him that I had taken out a patent for the process he strongly advised me not to dabble with patents, that they did not pay, but he said, "When you can show 1000 tons of rails made by the process, then I will believe in it." Last week the same gentleman told me that he had recently had occasion to test 1000 tons of rails made by the process, as against 1000 made by the old plan, and that he found no difference whatever. I think no stronger evidence than this could be given of the technical success of the plans. I would only, in concluding my remarks, ask the members of the Institute to assist us in following out the recommended action of the Presidency at the Liverpool meeting in devising some better and more honest title for this process than the Thomas-Gilchrist process, by which it is at present known. The process is now being worked under the controlling patents, and I maintain that by priority of invention and by the arbitratory award, the name now applied to the process is both unfair and misleading. I have ventured to suggest the term "basic" process; as a neutral title would be more just to all who have assisted in making the process complete, and altogether more convenient.

Mr. Riley said he had been inspecting and testing steel from week to week, extending from the begining of December up to the present time. He might tell them that he had learned from Mr. Pink that the Thomas-Gilchrist steel and the steel made in the ordinary acid converters were sent off promiscuously, to get those blooms, to America. But they made in America 12,000 to 15,000, and he believed that we were only making from six to seven thousand per month. These ingots were rolled into rails every now and then, and they were tested to see if they were free from defects, and the ingots were taken out and they were rolled into rails. The rails were taken mechanically, and the drillings were taken from the rails and the drillings were sent over to him. He had eleven analyses of those rails after they had been tested mechanically, and all the mechanical tests had been satisfactory, and, as Mr. Pink had said, as the ingots were mixed, he could not say whether it was Thomas-Gilchrist steel, or steel made in the ordinary way; but, looking over the results, he thought it a very fair inference to say that those drillings that were exceedingly low in silicon were, in all probability—he might say almost certainly—made by the Thomas-Gilchrist process. He might tell them that steel made in Germany differed from the English steel in containing a higher percentage of silicon and more phosphorus than the English steel did. Although he did not wish to insist too strongly upon that point, he thought it showed that the phosphorus could be efficiently—and he believed more efficiently—eliminated from phosphoric pig than in the ordinary Bessemer process. For soft steel the latter carries off the palm; and this I attribute to the complete elimination of the silicon, to the mixture of different brands of pig, and to the absolute certainty with which the carbon in the finished steel can be controlled. He thought, as regarded the Bessemer process and the Bessemer lining, that they could perfectly eliminate the silicon; and he thought that was not a valid argument for preferring the Siemens process against the Bessemer process. He had seen this process at Horde and at other places, and he must say that there were no difficulties but what could be got over.

Mr. Richards said he had jotted down a few figures as to the progress made during the past twelve months. There were three points that he wished to bring forward. First of all, the use of white iron; secondly, fire-clay bricks in lieu of basic bricks; and thirdly, the heating of lime. The reason why we did not use white iron in Cleveland was simply that the sulphur got very high, owing to the cold condition of the blast-furnaces. They knew very well that sulphur was a very objectionable thing in steel. They found that when the sulphur was about $2\frac{1}{10}$ with the steel there was red heat; in spite of what Mr. Snelus had said, they had good results with forged steel. When we first started experimenting at Middlesborough, Mr. Thomas, in reply to his question, said that phosphorus gave out heat, and that silicon was unnecessary, but he had always been afraid to try white iron because of the sulphur, but they had examined results with forged iron.

Mr. Richards, on being called by the President, said they had been using the Thomas-Gilchrist process at Bolckow, Vaughan, and Co.'s, and they found out the turn out in quantity was not sufficient, and they consequently turned their attention to laying down more effective plants, and that plant had been put down in one case, and they were expecting to put another down in a week, and with this they hoped to be in full working order in two months.

(*Continued on page* 331.)

NEW SAFETY BOILER FITTINGS.

BY MESSRS. A. H. BATEMAN AND CO., EAST GREENWICH.

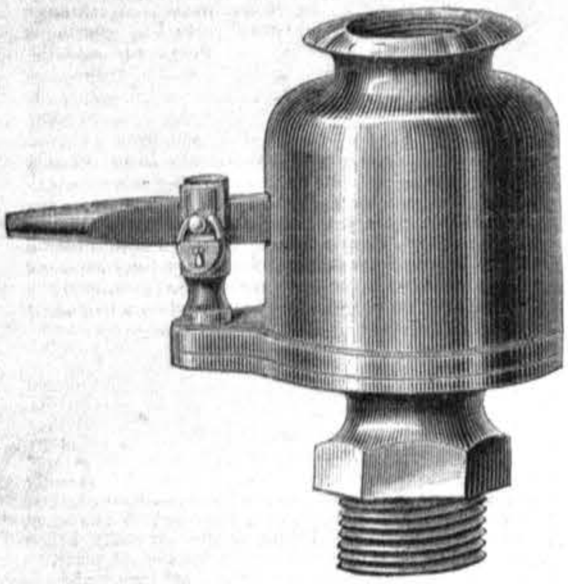


Fig. 1.

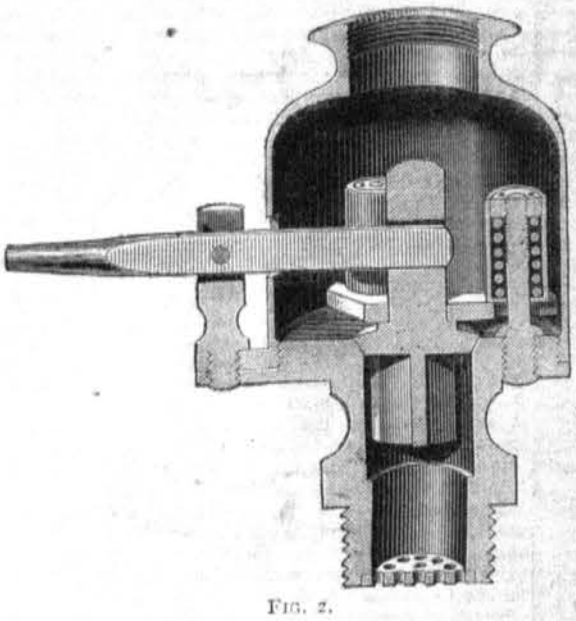


Fig. 2.

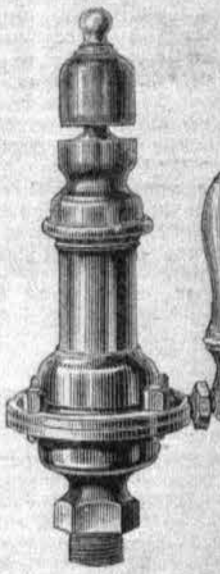


Fig. 6.

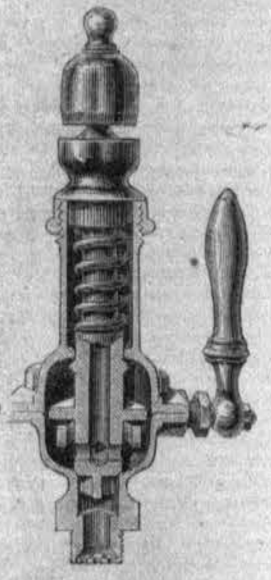


Fig. 7.

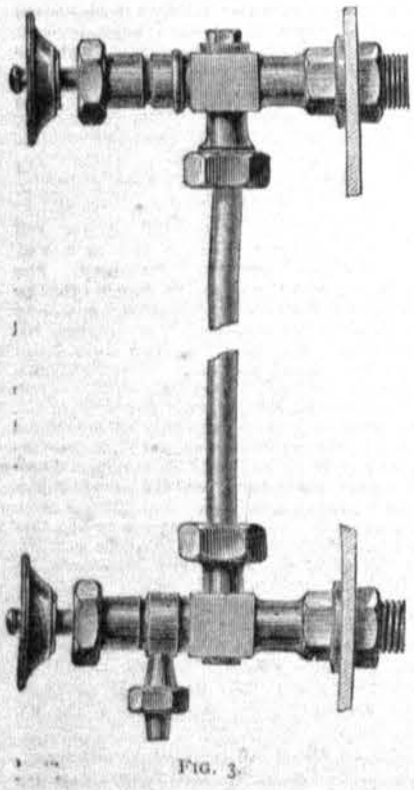


Fig. 3.

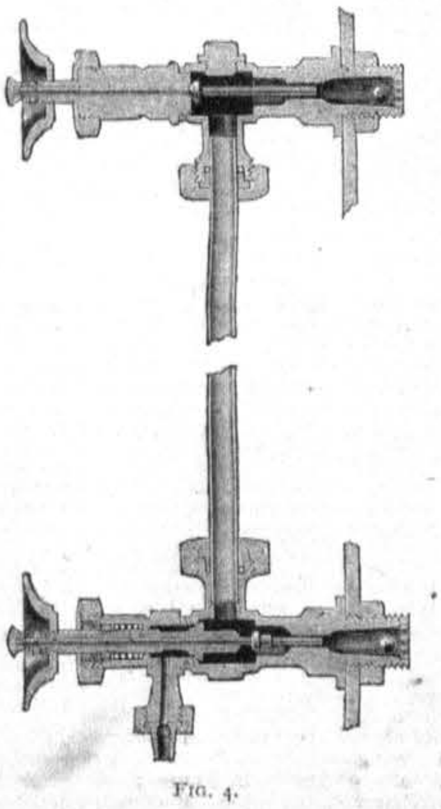


Fig. 4.

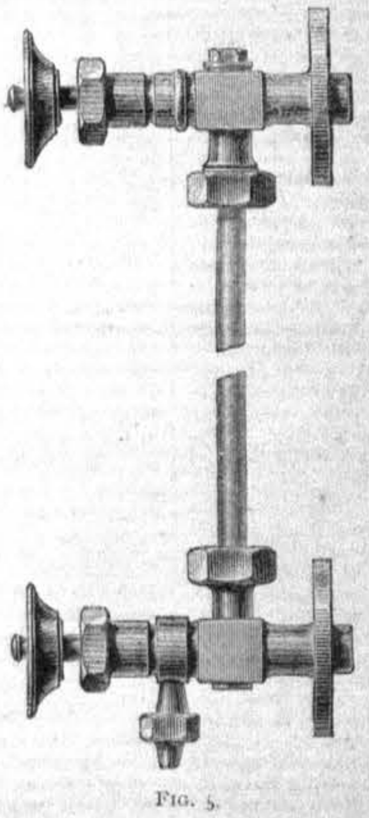


Fig. 5.

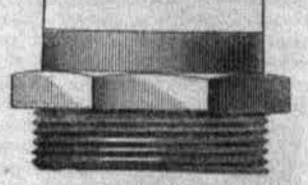


Fig. 10.

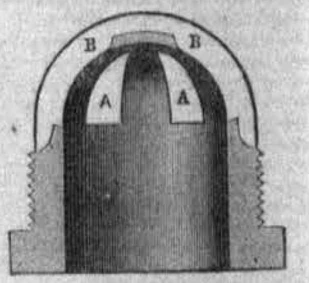


Fig. 11.

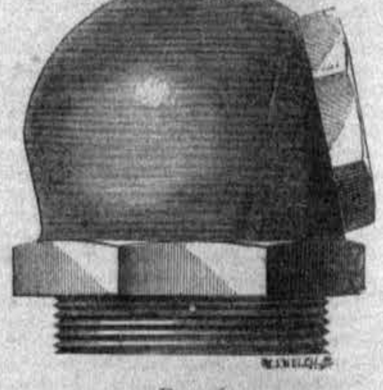


Fig. 16.

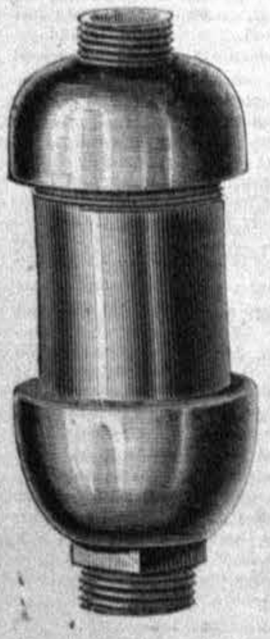


Fig. 8.

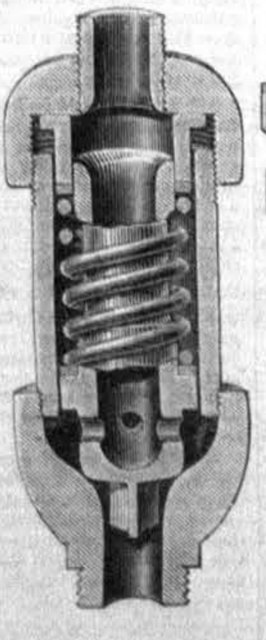


Fig. 9.

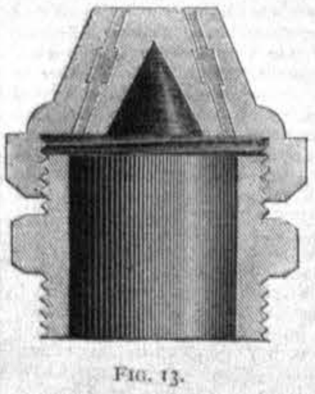


Fig. 13.

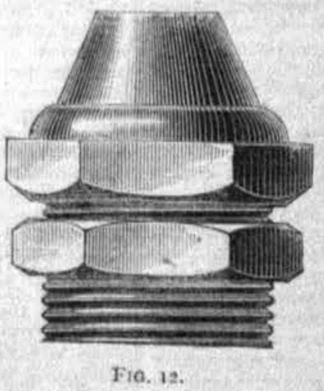


Fig. 12.

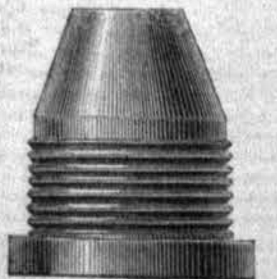


Fig. 14.

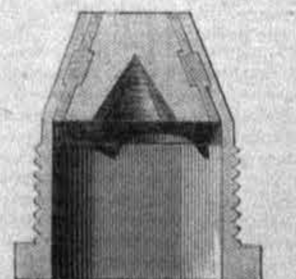


Fig. 15.

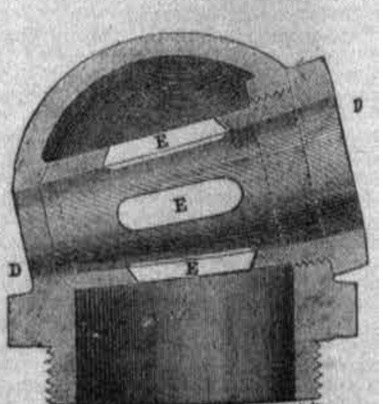
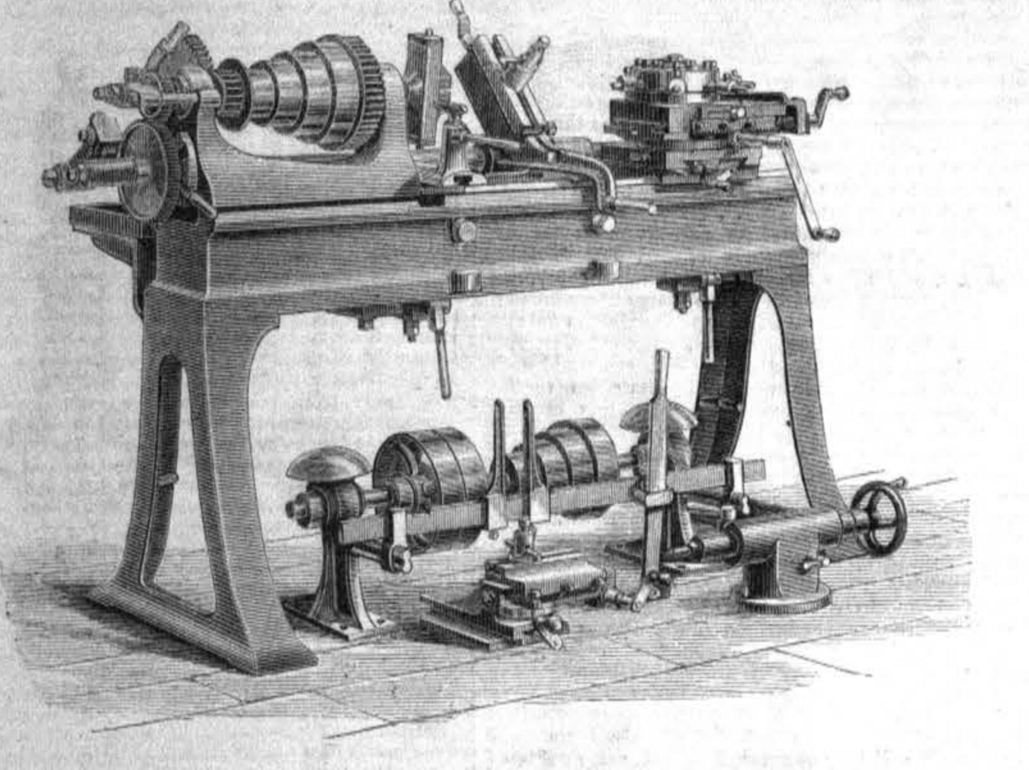


Fig. 17.

BRASS-FINISHERS' LATHE.

BY MESSRS. SMITH AND COVENTRY.



BATEMAN'S NEW BOILER FITTINGS.

TOO little attention is, as a rule, bestowed on boiler fittings. Vertical engines and boilers combined are frequently got up at a low price, "including the usual boiler fittings," which are made by the gross, on the same pattern that has done duty these thirty years, and are often put on and delivered without any previous testing. What wonder, then, that disappointment, failure or accident are the result? We are glad to find that a mechanical engineer of Mr. A. H. Bateman's experience has turned his attention to the improvement of these highly important accessories, which we recently had the opportunity of inspecting, at his works, East Greenwich. An appliance that is only used when wanted is often found wanting when used; for instance, the float which never falls below a certain point sticks fast when it ought to fall. One great principle, therefore, which has been followed, in designing most of the fittings under notice, is to afford means for working them by hand from time to time, and thus avoid any danger of their setting fast or becoming encrusted, so that they may always be ready to act automatically.

SAFETY VALVE.

It is not alone in Mississipi steam-boats that boiler explosions through tampering with the safety-valve are to be feared. Only a month or two ago an engineer on board a steamer plying on the Floating Harbour, Bristol, was charged with wedging down the safety-valve, and thereby endangering the lives of the passengers. It is highly important that these appliances should be placed beyond the control of rash or ignorant persons. The object in designing the valve under notice was to protect it from the possibility of being tampered with, and at the same time to produce a small, simple, compact and efficient valve, sensitive enough to prevent any difference from being observable on the pressure gauge, and yet not so extremely sensitive as to blow off and close again immediately, every two or three seconds. It was also considered that, by distributing the pressure over three small springs instead of using a single large one, there would be a greater amount of reliability.

Fig. 1 of the illustrations on page 328 shows an outside view, and fig. 2 a vertical section, of the Bateman safety-valve, which has already been applied to several boilers with perfect success. The valve itself, carefully ground in on its conical seat is guided by three knife-edges, so as to reduce friction, to a minimum; it can also be lifted off its seat by the lever, from time to time, so as to make sure that it has not set fast. The valve is kept down by three copper-coated spiral steel springs, contained in cylindrical brass boxes, so as to be thoroughly protected. The springs, which act on a three-branched plate, are all screwed down separately to the given load; and, after being tested by the direct pressure of steam, the valve is marked at that pressure, and then enclosed, so that it cannot be altered, although perfectly open to inspection. The case is first screwed on; then the pillar forming the fulcrum for the lever is screwed in; and finally the pin inserted, with a padlock in its end, as shown in the outside view. The female screw in the upper part of the case, while being useful in manufacture, serves to connect a leading pipe for taking off the waste steam. The utmost nicety of adjustment is obtained, from 10 to 300 lb. per square inch, or even more.

SAFETY WATER GAUGE.

The breakage of a water-gauge glass is of frequent occurrence. Not long ago the torpedo-boat *Herreshoff* collided with a large vessel off Portsmouth, her gauge-glass becoming fractured in the shock. The fragments, scattered in all directions, wounded the engineer in the knee, and also injured another man so severely that he had to go to the hospital. On locomotives the danger is still greater, owing to the close proximity of the glass to the men on the foot-plate; indeed, drivers and firemen on many railways have lost their eye-sight from this cause. It is the practice in such cases to throw a coat over the broken gauge (whence steam and water are issuing with all the force due to the boiler pressure), and to feel about for the cocks and turn them off. But the cocks often stick, and hands get fearfully scalded before the leak is stopped; it is, besides, evident that, in such an emergency, signals may be passed unheeded, to the risk of a more serious accident. In Mr. Bateman's new gauge, cocks are superseded by valves, which close immediately on the glass breaking, and thus prevent the escape of all but the steam and water actually contained in the glass.

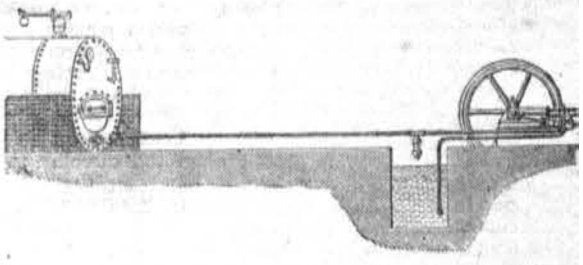
Fig. 3 shows the form of this water-gauge provided with back nuts, and fig. 4 a section of the same, while fig. 5 shows the form with flanges generally used on locomotive boilers. In the plugs which enter the boiler-plates are formed conical valve-seats capable of being closed by gun-metal balls, which in the section are shown in their normal position, lying down at the bottom of the tube, and permitting of the free passage over them of steam and water from the boiler to the glass. In the event of the glass breaking, however, the pressure in the boiler, opposed only by that of the atmosphere, drives the balls tight up against their conical seats, and so effectually prevents any further escape of steam or water. The fragments of glass may then be removed and a new glass inserted, or even the whole gauge may be dismounted, as long as the two plugs are left in the boiler. We saw, the other day, at East Greenwich, a gauge-glass purposely broken while the boiler was under full steam-pressure, when an instantaneous puff of steam was all that followed. To restore the water-gauge to its normal condition, the central needles are pushed forward to unseat the balls, thus allowing the passage of steam and water, which restores the equilibrium. The lower fitting of the gauge is also provided with an asbestos-packed plug, having a conical valve face, kept tight against its seat by a spiral spring, for emptying the glass. When both the needles and the plug are pushed forward at the same time, the glass is blown through in the ordinary way. The balls are made thoroughly spherical by being cupped several times in the lathe; and the tightness of the joint that they make with their seats is tested by means of water.

STEAM SENTINEL.

This appliance, intended as an additional means of safety, in case other fittings should fail through setting fast or becoming encrusted, consists of a shut-up safety-valve combined with whistle, to which Mr. Bateman has added a lever for raising the valve off its seat from time to time. Fig. 6 shows an outside view, and fig. 7 a section, of the steam sentinel, which is double-seated, thereby preventing the steam from having access to the spring. The steam, after leaving the valve, passes up through the centre of the hollow spindle, thereby getting a direct thrust on the spring, and blows the whistle. The valve is fitted with guides on the knife-edge principle, thereby preventing any resistance to its action when the determined pressure is exceeded. The sentinels are made to suit boilers from 1 to 1000 horse-power, and several thousands have already been applied.

WATER RELIEF VALVE.

The want has long been felt of a simple relief valve, to prevent the fracture of pipes and joints in connection with steam pumps, through over-pressure of water. Fig. 8 shows an outside view, and fig. 9 a section, of this contrivance, the application of which will be understood by the annexed sketch.



In the pipe leading from the feed-pump to the boiler, is inserted a T-piece, put in communication, in any convenient manner, with the relief valve, to which a waste-pipe may be connected. Being screwed to any desired pressure (say 100 lb. to the square inch), well within the strength of the pipes, the valve remains closed so long as the pressure in the boiler is below that point, and there is a fair way for the water; but, if the pump throw more than the pipe can well carry, or if the water be turned off entirely or partially at the boiler, the spring will yield, and allow the whole or part, as the case may be, of the water to pass into the waste-pipe. The latter should be arranged so as to discharge into the pump well, when no waste of water will occur; and the pump, if fixed to the engine, can always be allowed to work at full power (in which case alone can small pumps be depended upon). The amount of water delivered to the boiler depends on the shut-off valve fixed on the boiler itself; and the quantity supplied can be regulated to the utmost nicety according to the rate of evaporation, the excess passing back by the relief valve into the pump well.

FUSIBLE PLUGS.

These small adjuncts, of which there are sixteen different sizes and patterns, prevent all danger of the collapse of flues from shortness of water. They are made of gun-metal, with portions consisting of fusible metal, and may either be screwed downwards from the inside of the boiler, or upwards from the firebox; but, in any case, the fusible metal is arranged so as to be not less than half an inch from the top of the flue-plate. If the water should fall so low as to expose the fusible metal, it would at once melt, and thus afford an aperture for the water to rush into the firebox and put out the fire. Fig. 10 shows the dome-shaped plug for screwing downwards, and fig. 11 a vertical section of the same as as arranged for screwing upwards. The fusible metal metal is marked AA, BB. Figs. 12 to 15 show a good arrangement of conical plug, in which an inner cone of gun-metal is held inside the outer shell by a kind of dovetailed ring of fusible metal, as is apparent in the sections. If this should melt owing to deficiency of water, the whole inner cone drops bodily into the firebox, and so affords a relatively large orifice for the water to enter. Figs. 16 and 17 show the globe pattern of plug, with conical tube, DD, which, being set at an angle, causes a constant current, thus preventing incrustation by bad water. The fusible metal is shown at E, E, E. By the use of these fusible plugs a material reduction is effected on insurance premiums.

BRASS-FINISHERS' LATHE.

THE annexed engraving represents Cooper's patent brass-finishers' lathe which, in its main features is the same that has become so extensively used in American brass-finishing works, and by means of which, combined with other labour-saving appliances, the American producer has been able to introduce most highly finished brass-work into this country, and undersell the British manufacturer. Messrs. Smith and Coventry of the Gresley Iron-works Manchester, have undertaken the introduction of this tool into this country, being sole licensees, and in their hands it has been much improved in its details, and may justly be said to be the most complete tool ever devised for the purpose. Its great merit consists in the speedy manner with which it will produce large quantities of work of exact uniformity in pitch and diameter by unskilled labour, and the extreme simplicity of arrangements for changing without loss of time from one kind of work to another, thus meeting the requirements of the specialist as well as the general jobbing worker. The many excellent motions devised to supersede hand labour and acting with unerring precision, combined with great handiness for bringing up each one of these motions as required, secures for it advantages such as no other tool can lay claim to, and constitutes it the most formidable rival hand labour, however skilled, has yet had to encounter. Its general features will be readily understood from the engraving, which shows both the turret rest and loose headstock, either of which can be used according to the class of work to be tooled. The turret-rest with its slides is placed upon a lower slide secured to the bed by lever locking arrangement, and having a transverse motion with screw and handle for surfacing at right angles to bed; a second slide swivels upon this and can be set to an index to obtain any required taper; motion is given to the turret rest upon this slide by means of a screw and handle thrown into gear by a clasp nut, or a quick movement obtained by rack and pinion placed conveniently to the front. The turret rest when run back can be revolved and locked by means of a spring and catch, bringing the next tool into position ready for work; by this arrangement each of the six tools can be used in succession without being unset. The loose headstock is placed upon the circular ring forming part of lower slide, on removing the turret-rest from it, and is arranged to bore parellel or conical with stops for securing correct diameter, also for facing up to 11-inches diameter. The screw-chasing apparatus consists of a tool slide swinging upon a shaft at the back of the lathe, and falling into gear with a short guide screw driven from lathe spindle; it carries the chasing tool forward in correct pitch, and an adjustable stop or slide secures the exact diameter of thread. A patent compound rest is supplied for turning between centres, having both handles worked from the front and arranged to fit square on to the bottom plate of the hand-rest, either of which can be removed instantly when not required. The most important working parts of the lathe are made of steel, and strong enough to make 3-inch iron body wheel valves; at same time, the lathe is so easily handled that the slightest and most delicate brass-work can be made upon it with the utmost facility. Height of centres of headstocks 8 inches.

THE UTILISATION OF TINNED-IRON WASTE.

IN spite of the advance of science in modern times our iron industries are still burdened with several waste products. These necessarily increase the price of the finished article, and will continue to do so until some remunerative application is found for them. Iron slag is undoubtedly the most important and at the same time the most hopeless, on account of its enormous bulk. Another important waste product, but one which is more easily dealt with, consists of the cuttings of tin-plate. In working up this material into various articles, such as cannisters, boxes and the like, there is an unavoidable waste of about 6 per cent., and the total quantity of tin-plate thus wasted amounts to several thousand tons per annum. The amount of tinned iron thrown away in the form of discarded food tins and cannisters is very much greater. Some idea of the quantity may be formed from the following figures relating to the production of tinned provisions. Nova Scotia and New Brunswick produce annually 5,000,000 1-lb. tins of lobster, while from the lower Columbia River alone 19,000,000 1-lb. tins of salmon were exported in 1876. Baltimore uses 45,000,000 cans annually, chiefly for packing fruit and vegetables, while Nantes consumes every year 2750 tons of tin-plate for similar purposes. The whole of this metal is thrown away after it has served its purpose, no use having hitherto been found for it. Some years ago an attempt was made by some enterprising costermongers to utilise the solder contained in some of these waste tins. When a considerable number had been collected they were heaped up and covered with sawdust. This was ignited, and those portions of solder which dropped off into the ashes were afterwards collected and run down together. As this business was soon abandoned, we must conclude that it did not prove remunerative. Several patents have been based upon the assumption that if tinned plate be heated the tin will run off and can be collected. To those acquainted with the tin-plate manufacture, however, it will be evident that very little, if any, tin can be separated in this manner, as the manufacturers very carefully remove all superfluous tin before the plates leave their hands.

There is a very thin external layer of pure tin upon the surface of tinned plate, and between this and the iron itself lies an alloy of tin and iron, which has been one of the chief sources of difficulty in extracting the tin from tinned iron. This separation can no doubt be effected by the aid of hydrochloric acid; but the expense of such a method is much too great to allow of its success in practice. When the aid of electricity or galvanism is called in, the expenditure for acid may be diminished; but the economy in this direction is more than compensated for by the cost of generating the electricity. A system of separating the tin by means of gaseous chlorine was for some time worked successfully in the United States, but had ultimately to be abandoned on account of the difficulty of reducing the tin to a saleable form after separation from the iron. The chief source of profit in this case was the scrap iron, which sold for $40 per ton. At the present moment, as Mr. Flower says in his interesting work on the History of Tin and Tin-Plate:—"Tin-plate scrap is next to valueless. . . . although scrap iron has an important value for re-conversion in the forge." The recent patent of Mr. W. F. Reid, however, which has for some time been successfully worked, meets a long-felt want by very simple means. By this process it is stated that the tin can be extracted from tin-plate cuttings, old food-tins, and the like, at a moderate cost. When covered with paint or varnish—insurmountable obstacles to the old acid or pickling systems—waste tins may be successfully treated by this method, even the lead contained in the paint being recovered and utilised. Instead of employing expensive chemicals, Mr. Reid effects the separation of tin from iron by means of coal or coke, preferring, however, the latter. The tinned scrap or waste is first roasted until the external coating of tin and the alloy of iron and tin underneath it are oxidised. These two layers form about one-tenth of the total thickness of ordinary tin-plate, the remaining nine-tenths being metallic iron of the best quality. When the whole of the tin and part of the iron are oxidised the process is interrupted. The scrap is now found to be covered with a brown, brittle scale, the outer part of which consists of nearly pure oxide of tin, while the inner portions are chiefly composed of magnetic oxide of iron. The roasted scrap next passes under edge-runners, which completely remove the mixed oxides of iron and tin in the form of a powder.

In order to reduce the iron to a saleable form nothing now remains but to separate this powder by means of a sieve. The iron thus obtained can be converted into either wrought or cast iron of excellent quality, or it can be used at once for precipitating copper, a purpose for which its exceptional purity renders it peculiarly applicable. The powder which passes through the sieve finds a ready market as a valuable ore of tin. It is free from such injurious impurities as sulphur and arsenic, which renders the treatment of some natural tin ores so difficult. It can be reduced direct to a tin of good quality or, the oxide of iron may be separated by means of sulphuric acid, leaving the oxide of tin unaltered in the form of putty powder. Experimental plant has been erected to work this process, the result having proved highly satisfactory. As the utilisation of any waste product, especially one of such importance, must be advantageous to both producers and consumers, we cannot but wish this new industry every success.

SLAG CEMENT.

WE lately directed the attention of our readers to some important investigations which were being made by Mr. Frederick Ransome respecting the properties of the sand produced from the slag of blast-furnaces in connection with the manufacture of hydraulic cement, and we then gave particulars of some remarkable results obtained by that gentleman.* We are glad to learn that those results have been confirmed by Mr. Ransome's subsequent experiments and more extended operations, in which he has successfully treated various other slags from different localities, and has been able to obtain greatly increased results beyond those which were noticed by us as already stated. Particulars of these fresh results we hope shortly to be enabled to place before our readers. It would appear that Mr. Ransome's process of manufacture, instead of being restricted to one locality or to one class of blast-furnace, slag, as it previously was, can now be carried out in all parts of the kingdom where slag is produced, no matter—within certain limits—what the chemical proportions of that slag may be. The manufacture of hydraulic cements has hitherto been confined within very narrow limits as regards locality, requiring very heavy outlay for plant, in order to effect the chemical combination of the silica, lime and alumina so essential to the production of hydraulic cement. In blast-furnace slag this combination has already been completely effected before the slag has left the furnaces, and generally in such proportion, as regards the silica and alumina, as is required. By subsequent admixture with an additional quantity of lime and calcination this produces an exceedingly strong and reliable cement of an agreeable colour. In view of Mr. Ransome's recent experiments we see no reason why the millions of tons of slag produced annually from the blast-furnaces, and which hitherto have involved the ironmasters in large outlays for places of deposit, may not in the future prove a source of profit to the producer and furnish a valuable material in the extension of our national industries. The subject is well worthy the attention, not only of ironmasters, but also of the members of the engineering and architectural professions, and we wish the inventor the success he justly deserves.

OUR TRADE SUMMARY.

DULNESS to a considerable degree continues to characterise almost every branch of the iron trade, and prices generally show no sign of recovery. In the Glasgow warrant market, indeed, capitalists have been purchasing lately under the impression that iron at present rates is a safe investment; but even there a further fall is confidently expected. The closing prices for warrants were, sellers 47s. cash, and 47s. 1½d. a month; buyers very near. Makers are doing little business, and are considering a reduction of wages. The highest quotation for makers' iron is for No. 1 Gartsherrie, 55s. The amount in Connal's store is now 438,486 tons. The manufactured trade continues very dull, although some of the large rolling mills are fully employed. The shipbuilders are pretty busy; but the launches are in excess of the new orders. Quietness prevails in all the other iron industries of the city and district. There was more firmness at Middlesborough on Tuesday, and more buyers, and rates rose 6d. per ton towards the close of the market. The finished trade has been dull, the only thing of interest connected with it having been the futile strike of the workmen against the operation of the sliding scale. Bars are selling at £6 5s., ship plates at £7. 8s. a ton. In the Tyne district trade has been disturbed by the strike; but the demand for pig-iron is regarded as in an improving condition, the low rates stimulating inquiries. Prices are believed to have touched their lowest point, and there has actually been a rise of a few shillings. There is no slackening in the engineering and shipbuilding trades, and it is hoped that the low price at which the raw material now stands will give a fresh impetus to the latter industry. In the Durham district considerable dislocation has been caused by the strike, which, however, is not now expected to last any time. The men in some localities have already given in, and the rest will follow before long. A very quiet demand, with falling prices, is reported from the hematite districts of the north-west; but the large deliveries remaining to be made on account will occupy makers for some months to come. At the same time there is still great activity both in the ironworks and in the shipbuilding and engineering establishments. There is still a large output of ore, which is in considerable demand though at somewhat lower prices. The Manchester market of Tuesday was more active, but there was no real improvement and the legitimate demand was rather small, the low rates encouraging speculative purchases. There has been but little doing in the finished trade. In some of the less important centres such as Lincoln and Derby a better state of things seems to prevail; but both Yorkshire and Staffordshire are suffering with the rest of the country. In the latter the dulness is apparent both in the home and foreign market, and in the finished as well as the pig-iron manufacture. From South and West Yorkshire the accounts are equally unsatisfactory; but an improvement in shipbuilders', railway and engineers' work is confidently anticipated, and that before long. The demand for ship plates is on the increase, stimulated by reduced rates, and steel ship plates are also largely inquired for; while there is a renewed activity in the manufacture of armour plates. In the Sheffield cutlery trade there is an excessive demand for lower class goods; for the better sort the demand is also increasing. The file houses are especially busy. Business in the local hardware branches in Birmingham is less satisfactory, iron hardwares being in a worse position than brass or copper goods. The kindred trades of South Staffordshire are also considerably depressed. Dulness continues to prevail in the coal trade, and even where the demand has increased slightly there is no advance in prices.

OCCASIONAL NOTES.

THE WORKING CLASS AND TEMPERANCE.

THERE is nothing so deceptive as figures; statistics may be manipulated to prove anything. But although there has been no reduction to speak of in the number of public-houses, and although the increase in the consumption of tea and coffee, as shown in the revenue returns, may be interpreted as signifying poverty as much as temperance, there can still be little doubt that drunkenness is diminishing in England. And this satisfactory improvement owes little comparatively to the action of well-meaning enthusiasts; the counter-attractions to the tavern, which never were so many as now, have had a great deal more to do with it. Athletic sports, such as cricket, football, bicycling, which have become so popular of late, are incompatible with tippling; the Volunteer movement has also done its part; and the spread of refinement, shown in the increasing interest of the masses in art, science and literature, has largely helped in the good work. It is in this direction that the friends of the working classes should act; and it is satisfactory to find that, both in London and the provinces, many large employers have assisted their clerks and others in establishing clubs for various purposes, athletic, musical, or scientific, and collecting libraries—in one case of eight thousand volumes.

---

* See IRON, vol. xiv., p. 355.

REACTION IN THE IRON TRADE.

A considerable amount of unnecessary apprehension regarding the future of the iron trade has been occasioned by the recent lull in the market, the result of a temporary cessation in the American demand, and the anxiety of weak holders, who had bought for speculative purposes, to get rid of their stocks. A very little consideration will show that the iron market is in a very different condition from what it was in a year ago. The enormous stocks that were then accumulated have been almost cleared off everywhere, chiefly absorbed in home consumption; and the largely increased production at the present time barely exceeds what is required to supply the current demand. The shipbuilding trade, which was scarcely ever in a more thriving condition, must be taking very large supplies of raw material; and many other important iron industries are not very far behind it. Much iron is still being exported, and the harvests of India, Egypt, Spain and South Russia promise to be more bounteous than they have been for several years, which means an increased demand for English manufactures, including those in iron; and should this happy state of things prove to be general, as there is at present every indication, we may look for settled prosperity. The American demand, too, has only slackened; it is quite possible that in the course of the year the United States will require at least three-quarters of a million tons to supplement their own production, the extent of which has been considerably exaggerated, while the capacity of the English furnaces has probably been equally over-estimated.

A SYMPATHETIC DIAL.

Some time ago an ingenious American proposed to reduce the friction of the bicycle by turning it into a monocycle, and it was suggested that the abolition of the remaining wheel would be a further improvement. According to the Cleveland (U.S.) *Leader* this eliminatory process has been successfully applied to the electric telegraph. This latest transatlantic canard describes the new instrument, which is named the Automatic Indicator, as looking like a pocket compass. "Instead, however," the *Leader* goes on to say, "of having the points of direction marked on the circle described by the end of the needle, it has the letters of the alphabet. The needle is of different metallic composition than the compass needle, and has been 'affiliated magnetically' with one or more needles of similar instruments. By the newly-discovered principle the needles of two or more instruments are brought into such relation that, when one needle is moving on its point to a certain letter on the disc, the needle of the other makes precisely the same movement and points to the same letter." The way in which the "Indicator" is operated is described as follows:—A and B each has a properly "affiliated" "automatic indicator." A goes to San Francisco, while B remains at home. A wishes to communicate with B. He takes out his "indicator," and by means of a key moves the needle of it from one letter to the other, spelling out what he wishes to say. As fast as his needle moves from letter to letter the needle in B's instrument makes a corresponding motion. In reply B moves his needle in the same manner, and A's needle spells out the answer. In case A's instrument is in his pocket when B wishes to call him, his attention is attracted by the ringing of a delicate bell like that of a repeater watch, which is attached to the "indicator," and rung by the needle in its efforts to follow the movements of its far-off affinity in the hands of B. This engagingly simple apparatus would enable its possessor to dispense with telegraph and telephone companies, but it is sadly to be feared that the account of it is only an amplification of the early myth of a sympathetic needle, which subsequently supplied a theme to the essayists of Queen Anne's reign.

ARTISTS' MATERIALS.

The most precious artistic work—that of the painter—is also the most unstable and uncertain in its duration. Besides the risk of damage from fire and other accidents, the canvas may fail, and what is the most common deterioration of all, the colouring, on which so much of the beauty and effect of the painting depends, becomes impaired by time, from chemical change in the pigments. When that change only goes on to a limited extent, or in a certain direction, the result is rather pleasing than otherwise, leading to a softening and blending of the tints; but frequently, especially in the works of our later painters, and particularly where asphalt has been employed as a medium, an almost complete disintegtation has taken place, of which some of our picture galleries furnish painful evidence. The early artists manufactured their own pigments; and, as Mr. Holman Hunt in his recent address on the subject showed, the works of some of these are still bright, even the more precarious colours being preserved. In later times the preparation of artists' materials has fallen almost wholly into the hands of tradesmen, to whose general character and skill Mr. Hunt bore cordial testimony, at the same time remarking that the colourman had no opportunity of testing the condition or action of his goods after they had left his shop, and was to a considerable extent dependent for their proper manufacture upon his workmen. Besides, from the great extent to which adulteration is now carried, the utmost care is necessary in testing the raw material of any delicate manufacture. It was stated that pure oil could not be used, because the linseed imported is always more or less mixed with other and inferior seeds, while the canvas is also partly woven of inferior fibre. Mr. Hunt's paper was read in connection with a proposal to form a society with a museum and laboratory for the purpose of ascertaining and recording facts in relation to the materials used by artists, and of training art-students in the mechanics and chemistry of their profession, and the object seems to be one worth pursuing. The painters will, however, have some difficulty in getting out of the habit of relying on the colourmen, who do not like the prospect of any change, if we may judge from the brisk controversy which Mr. Hunt's paper has occasioned.

LONDON HOUSES.

Visitors to the metropolis perhaps carry away an exalted idea of the wealth of its inhabitants as much from the contemplation of the rows on rows of stately mansions which extend throughout the numerous suburbs on every side, as from its richly furnished shops or lofty warehouses. But all is not gold that glitters; and if we may judge from a correspondence that has been for some time going on in one of the daily papers, very many of the London palaces are hotbeds of typhoid quite as much as its reeking slums, which are a scandal to civilisation. In the correspondence alluded to there is the description of a house in the fashionable district of South Kensington, built during the last ten years, and taken with the assurance that the sanitary arrangements were of the latest and best, including a ventilating pipe from the drains. It turned out that the ventilating pipe terminated within a few inches of one of the windows and discharged into the house, the drainage pipe under the basement had leaked and saturated the soil, and a cesspool completely filled with sewage was found under the area flags. In another case, continual sickness in his family induced the householder to investigate, and he discovered a similar state of matters underground. A medical man in Bromley, whose wife and seven children were stricken down by typhoid, found the cause in the condition of his drains. In a mansion near the Gloucester Road Station there had been much sickness, especially among the servants, for years. Recently the occupier ordered a strict examination, with the following results:—A pipe, intended to carry the sewer gas right away into the upper air, stopped far short of its proper altitude, and discharged the gas into a cistern from which the daily bedroom water was obtained. The drainage pipes put up and down the house were infamously leaky. The lower drainage, instead of being, as was supposed, connected with the main sewer, had no connected outlet whatever, but simply made its own cesspool under the area flags, whence three cartloads of accumulated horror were removed. The district of South Kensington, one of the newest, appears to be in a worse sanitary condition than any. A correspondent of the *Standard*, writing a day or two ago, asserts that he could name a street in it half of the houses in which are empty, "the former occupants having died of typhoid fever, or fled for their lives." It is probable, indeed, that not one house in twenty in the newer neighbourhoods is in a proper sanitary condition; and once a drain, or the place where it should be, is covered up, there is no way of easily ascertaining its existence or condition, for no plans of the drainage appear ever to be preserved. Until that is done and a strict public inspection insisted upon before the building is allowed to go on, there will be no safety for metropolitan householders: for even when the sewerage appears satisfactory at first the drains are often so badly built that they leak or get obstructed sooner or later. Perhaps in no respect were the shortcomings of the late Government greater than in the neglect of the motto which at the outset was emblazoned on their banner—"Sanitas sanitatum."

THE HANCOCK INSPIRATOR.—The Hancock Inspirator Company have just completed a very extensive addition to their works, rendered necessary by the rapidly increasing demand for this useful injector, which differs in some important respects from the instruments commonly classed under this head. It consists essentially of a lifting-jet and lifting-nozzle, combined with a forcing-jet and force-nozzle or injector, steam being admitted to both of these nozzles whenever the inspirator is in operation, to deliver the supply-water to the force-nozzle, and to force it through this nozzle into the boiler. Although both the lifting and force-nozzles are fixed, their proportion one to the other is such that the inspirator requires no adjustment for changes in steam-pressure or water-supply, the waste-valve being kept closed while the instrument is in operation, except at the time of starting. Whatever changes of adjustment are made, whether of steam or water-supply valves, within the capacity of the inspirator, the instrument will continue in operation with the waste-valve closed. In this respect the inspirator differs materially from fixed-nozzle injectors, which cannot be operated with the waste closed. The principle of the locomotive arrangement is the same as that of the stationary inspirator, but it is such that all the operations of starting and stopping can be performed by the movement of a single lever; and the instrument is self-contained, being ready for attachment without the use of additional valves. We understand that 9000 of these machines are now in use, and that they are daily growing in favour with our best engineers.

IRON AND STEEL INSTITUTE.

(*Continued from page* 327.)

Mr. Holley, of New York, said that they were employing the new process pretty generally in different parts of America, and as far as they were entitled to have any opinion, they considered that as they had a good deal of cheap phosphoric irnn in the United States that it would produce a large development of trade. The chemical premises were well known. The phosphorus was eliminated at a high and a long percentage, and the heat was kept up, and as far as the metallurgical process was concerned there were no difficulties. The great difficulty was the limited output, and the output would be only one half with the basic lining. But as these difficulties were to be overcome by mechanical means they did not despair.

Mr. Bell said he had from the first introduction of the process, as many members would recollect, taken a great interest in its progress and developments. Those of them who by reading or by recollection could contemplate the slowness with which Cort for example introduced the process of puddling, or even Sir Henry Bessemer the manufacture of Bessemer iron, had no reason to feel disappointed at the amount of advance which had been made by those gentlemen who had taken up the manufactnre of steel according to the basic treatment. At the same time he could not help feeling that there lay throughout the paper that had been read that morning, some indications of the wishes being a little the fathers of the thought. He thought that ultimately this would be not only a physical but a commercial success. Now, with regard to this great question of over-blow, about which apparently little importance was attached, he thought, by Mr. Snelus and others; as to which question Mr. Snelus in his remarks mentioned that there was an absence of brown smoke. Well, of course, he was not prepared to deny that in some cases that might not be the case; but this he was prepared, unequivocally prepared, to assert, that upon one occasion when he had had to watch the process himself—which he had been enabled not unfrequently to do by the courtesy and kindness of his friend Mr. Richards—he had not noticed the blow, according to the basic treatment, without a considerable evolution of brown smoke, so considerable, that the difference between it and the Bessemer process was of the most marked description. Now, if the over-blow were not required for the presence of iron, were no an absolute and indispensable condition of things, he would like to ask Mr. Snelus how he transferred the phosphorus existing, as used in the iron, to the lime. There was no doubt of this, that where the phosphorus in the slag, was found there in the condition of phosphate of iron or phosphate of lime, it was quite clear that it did exist as phosphoric acid. Now, he knew of no kind of reaction which could convert phosphorus into phosphate of lime, excepting by the interposition of oxygen gas. They required to convert phosphorus with phosphoric acid, and he should like to see Mr. Snelus set down upon the black board the reaction, which, out of phosphorus and lime, could give them phosphate of lime. He was not going to deny that they had the elements in the bath. They had free oxygen, no doubt, at the latter part of the process, at all events, streaming up through the iron; and having oxygen and phosphorus and lime, no doubt acids exist in the bath or the elements in the form of phosphate of lime. But he was not aware that that was the likely mode through which that particular form of reaction might be brought into operation. Well, now, it always had more or less iron in it, and he remarked this, that in the analyses which had been given, he thought there was a considerable quantity of iron in the slag, and the phosphorus remained pretty stationary, at least, such was the inference he had been enabled to gather from these various papers, and particularly from that of Mr. Pink. It could not be alleged that the presence of silica or silicon in the iron was the reason why the phosphorus still remained there, because in one—in the analyses of Mr. Pink, namely, the after-blow of 4½ minutes—the silica was reduced to ·009, an infinitesimally small quantity; and yet the phosphorus remained the same. It appeared to increase, until the latter portion of the blow—which, no doubt, was the after-blow. They got from Mr. Pink 17·6 per cent. metallic iron, but then taking it for protoxide iron, it indicated a considerable quantity of iron in the silicon. No doubt, to that allegation, Mr. Snelus replied that the waste in the after-blows given here by Mr. Pink, in his paper, indicated only a loss of ten per cent. or thereabouts. But, if he remembered rightly, in a subsequent part of the paper Mr. Pink said the charge being given only a loss of seven per cent., but the average loss came up to seventeen per cent. They had, therefore, after deducting the waste from the removal of the metalloids, a considerable waste of in the metallic iron itself. Then, with regard to what had been said in respect of the regularity of the process. Now, when he compared the results given here, and the results which they got on the North-Eastern Railway, and the quantity of phosphorus left in the rails delivered to them by Messrs. Bolckow, Vaughan and Co., he was bound to admit that in no case, so far as he knew, had there been any approximation made to regularity of the content of the phosphorus to that generally obtained in the use of ordinary hematite iron. These gentlemen, as well as others, had made large deliveries of rails from Bessemer iron, and although they knew there was a certain amount of irregularity in the quantity of the phosphorus in the pig-iron, the composition of the rails obtained from such pig was no more than might be expected from the irregularities in the quality of the pig-iron itself. When they came to examine well the character of the basic treatment, one was bound to admit that that regularity at once disappeared. They had met in the rails made by Messrs. Bolckow and Vaughan, made by the basic treatment, contained as low as ·05 per cent. of phosphorus; but, on the other hand, they had had articles containing as much as ·15, and every as much as ·2 per cent. of phosphorus. But he need not deal with mere speculation in this matter, because if they took the analyses that regularity appeared not to be justified by their own analyses. Here were twelve specimens given. Well, the lowest of these was ·04 per cent., the iron was ·11 per cent. Far from wishing to convey to the meeting the slightest despair of those gentlemen ultimately arriving at the same amount of security and regularity as were obtained now in the manufacture of rails made from hematite pig, he thought they ought to be careful in not laying down for their unqualifying acceptance opinions which, in his opinion, were not justified by the analyses given by themselves. He would like also to ask how it happened that invariably in all these analyses the carbon was so low. They had been rather led in the north, he did not know whether correctly or not, to the belief that one of the causes of the inferior durability of steel in the rails made at the present time, as compared with those delivered to them when the Bessemer process was introduced at first, had been due to an alteration in the quantity of the carbon. It was a most complicated question, and he did not know that they were prepared by figures to say that this was absolutely correct. Of course they were laying down rails, and if those rails did not last one half the time that steel rails did when they were first introduced in use upon the railways. But as they all knew those alterations might be due to a variety of circumstances. They had engines now very much heavier than before; they had greatly increased traffic, and were travelling at greater speeds, and if they had all those factors reduced to one common denomination it would be idle to deduce any correct comparison between the one and the other. But they were now endeavouring to introduce as much carbon in their rails on the North-Eastern as safety would indicate to be permissible, and they now had rails containing ·4 and ·5 per cent of carbon. He would like to hear from these gentlemen whether they have not much more than one-tenth of that, and instead of having ·4 they have ·04 four. He would like to prove whether that proceeded from circumstances the correctness of which no one would dispute that when in ordinary steel rails the carbon rose beyond a certain point they obtained a dangerously brittle article—why in steel rails made by the basic treatment the brittleness due the presence of carbon did not apply at a much earlier period in the rails if basic than in the rails made by the ordinary Bessemer process? Mr. Halley had spoken on a subject that had occupied a great deal of attention at their meetings, namely, that of the direct process, and, of course, dangerous as Mr. Halley said it was to prophecy too much, he ventured to prophecy in his humble judgment that the direct process was not a modification in the manufacture of iron which was likely to supersede the blast-furnace; of course, that opinion would be *ceteris paribus* if by means of the direct process you could produce an article of the high quality which you look to substitute for it equally and of a high price, then of course his objection fell to the ground for the manufacture of fire boxes for locomotive engines in America. He might remark that in the country steel was always invariably used. The steel as Mr. Holley had told them was manufactured from the use of charcoal blooms, in recent cases obtained by the Cattlin process. The Cattlin process was a direct process itself. Dr. Siemens' direct process was undoubtedly a very great improvement upon the Cattlin furnace. In the first place they got a great deal more work with the same amount of labour, and in the same time, and secondly—and that was a matter of the utmost importance—out of the worst kind of ore they could produce an article equal to that obtained from the purest ores, simply because during the process they were washing out the whole of the phosphorus by the presence of the oxide of iron, which was wanted during the process itself.

Mr. Riley said that some of the observations of Mr. Bell ought to be taken with a considerable qualification. Mr. Bell had taken Bolckow and Vaughan as representing the quantity of phosphorus present in English rails. That was not a fair standard. Messrs. Bolckow and Vaughan's iron contained a very low percentage of phosphorus, and that was due to their pure Spanish iron; but if they were to compare English rails with rails made by the direct process, they should take the average composition of the rails throughout the country, and he would be prepared to say that the average was far higher than those made by the direct process. His experience was quite contrary to Mr. Bell's, and it was ·45 and 5 per cent of carbon for steel rails, and it was therefore the quantity of phosphorus present in Bolckow and Vaughan's was not the criterion of the average in English rails.

The President: What is the percentage of phosphorus in English-made rails on the average?

Mr. Riley: Roughly speaking it is about seven hundredths or eight hundredths.

The President: The mean is ·07 to ·08.

Mr. Riley: Yes.

Mr. Bell said that Mr. Riley had entirely misunderstood what he wished to convey. What he said was this, that the same regularity which accompanied the manufacture of steel rails in the ordinary process, using Bessemer pig, was absent in the manufacture of rails by the basic treatment. He was not claiming that Messrs. Bolckow and Vaughan had any great superiority. He could quote Campbell, Wilson and others as having rails quite equal to those of Messrs. Bolckow and Vaughan; only he maintained that the claim for regularity in composition as regarded phosphorus compared with rails made from ordinary Bessemer pig did not obtain to the extent claimed by those gentlemen.

Mr. Allis observed that Mr. Richards seemed to be very low-spirited about the large quantity of iron made in America compared with that in England. Mr. Richards might keep up his spirits until they found out that the American rails were equal to the English. If we could not make very much quantity, at any rate we could make the quality, and when the Americans made the quality equal to theirs then he did not think he could give Mr. Richards any consolation whatever.

Mr. Thomas thought that they were indebted to Mr. Bell's criticism. The two points attacked were the question of quality, with which he combined regularity, and the question of waste. With regard to the quality he thought, without unfairness, he could make use of a letter which he received a short time since from M. Coupal Visier, in which he said that he was very well satisfied with the steel made by the Thomas Gilchrist process. He thought that after what they had heard from Mr. Riley and Mr. Ellis the contents in 0·3 per cent of phosphorus might be considered a fair result, and that 93 per cent of the whole process was contained in 0·3; and he might add that the demand for mild qualities was somewhat better than for the phosphorised. That question of mild quality brought them to another of Mr. Bell's points—that the carbon was low. He confessed that he felt rather unhappy when Mr. Bell mentioned that, because they rather plumed themselves on the carbon being low. It was a fact that mild steel with low carbon and great quality brought a higher price than hard steel, and that was a very good reason for making it, and with these analyses good low carbon was specially designed to make plate steel a higher quality than rail steel. Again, with respect to the question of the regularity which had been called in question, he would call Mr. Bell's attention to the fact that those ten or twelve analyses given by Mr. Cooper were unsampled steel; and, of course, if they made a high quality there would be one test, and by that means they would get that greater regularity which Mr. Bell would like to have. He would leave the question of carbon to be dealt with by Mr. Cooper, and the he thought that Mr. Cooper would tell them that there was no difficulty of putting in a quantity of carbon. It was generally considered that they had a little too much phosphorus and it was desirable perhaps not to have so much carbon. He did not think they had too much phosphorus, but it clearly would not be an objection if it were so. Then as to the question of waste. Mr. Pink had told them that the total waste was 17 per cent. and the production in ingots was 15 per cent. Sheffield and other steel makers thought that that was not an exaggarated figure for the hematite process. He thought it was possible if they had a waste of that, waste would be excessively low, at all events it would be very little in excess of the ordinary process. At Creusot they had found their waste excessively small and in Belgium again their waste for a period of six months had been 14 per cent., and in Austria had had good results. At their last meeting they had very few figures with respect to the open, hearth process. Since then the process had been working at Crusot, in two or three large furnaces and with very satisfactory results. A considerable number of castings had been made off one bottom with only the ordinary repairs, and the phosphorus was reduced to a very low point and the sulphur had been also much reduced. The question of sulphur was a very important one. He did not think that they could say much more except that the sulphur was two-thirds and in the Siemens it ran to 60 per cent and 70 per cent. That was in relation to the use of white pig and that had an important bearing when the use of manganese came into question. The use of manganese in the pig had a considerable advantage. It consisted of the removal of the phosphorus in the converter and it utilised its effect in the steel. They found it in a very considerable proportion—0·2, and sulphur could be tolerated with steel without sensibly affecting the quality, and it allowed the use of pig to 0·4. As to the question of sulphur, he had just taken up Mr. Bell's work, and he would give some of the figures as they came. There were nine analyses of Cleveland, four mottled, and number 3; and he found the average sulphur in these was 0·13, and the average silicon 1·2 in some cases. He did not know whether they should not be worked—at any rate, work at 2. They had a case of white iron ·09 silicon, ·06 sulphur, and ·01 phosphorus, and that was an excellent Bessemer pig. It was a little deficient in phosphorus, but that was a deficiency which could always be remedied. Continental experience seemed to point to the fact that they could put from ½ to 2 per cent. into a white pig without using an excessive quantity with the slack. That, of course, had an important bearing in two ways. They had the manganese and the pig to give that heat in the vessel, and they had a very complete removal of sulphur. The Scotch pig seemed to answer to the condition of the Horde and other plates with a little manganese, which in the Scotch pig was about one per cent.; and it answered very well. In the papers read by Mr. Holland and Mr. Cooper, it was an obvious inference that the very appreciable diminution of spiegel was got by a small quantity of manganese in the pig. The question of production was a very important one. The production, of course, was very small. Mr. Holley had told them, however, that it was an engineering problem, and he professed that he had every faith in leaving it in the hands of the engineers to solve. If the worst came to the worst, and if they wanted an American process, it was merely to change the vessel; and that was to remove a 30-ton vessel, and include the weight of the vessel and the lining about it. Mr. Snelus had said for some reason iron did not seem to be oxidised, and he had given them a theory. He did not know that he would agree with the theory laid down by Mr. Snelus, but there was another theory with an equal amount of probability, and that was simply in the phosphorus protecting itself. It was preferentially oxidised. If they had an oxidising metal, and two bodies, one of which was more readily oxidised, it was only natural to suppose that the more easily oxidised body, unless the conditions prevented oxidisation, would be preferentially oxidised, and therefore protect the iron, and also the manganese; and then they had again the question mentioned by Mr. Cooper, that at the last period of the blow they had preferential phosphorus over the manganese. They found that the phosphorus went very much mare rapidly out of the manganese than out of the speigel, and blowing out the carbon, and yet leaving sufficient manganese to make ·03 manganese, and using much less spiegel than working ordinary steel.

Mr. Stead remarked that in the basic process there was a considerable amount of iron lost in the red bloom, and he must confirm what Mr. Bell had said with reference to this red bloom at Eston. It was invariably produced at the after-blow. There was a considerable amount produced. In a very careful analysis conducted at Eston Steel Works he found that the minimum amount of loss, supposing the whole of the shot could be retained, and also supposing that no fumes passed above the converter, was not more than 10 per cent. That was working with the metal containing only ½ per cent. phosphorus and 1½ per cent. silicon. The loss of Bessemer pig-iron in phosphorus he calculated at 8 per cent. In analysing slags, before and after treatment, he took the Cleveland iron with a minimum of 10 per cent. and pure Bessemer pig at 8 per cent. They would have very nearly the same result, as far as the chemical part was concerned. It was a very important discovery and an addition to science, given them by Messrs. Holland and Cooper, in reference to the relative affinity or attraction of manganese.

Mr. Adamson remarked on the absence of sufficient data on which manufacturer, could decide upon the material that he would use for a given purpose, and he went on to give some interesting data himself from his practical experience in the manufacture of iron and steel.

Mr. Cowper supported the views of Mr. Adamson,

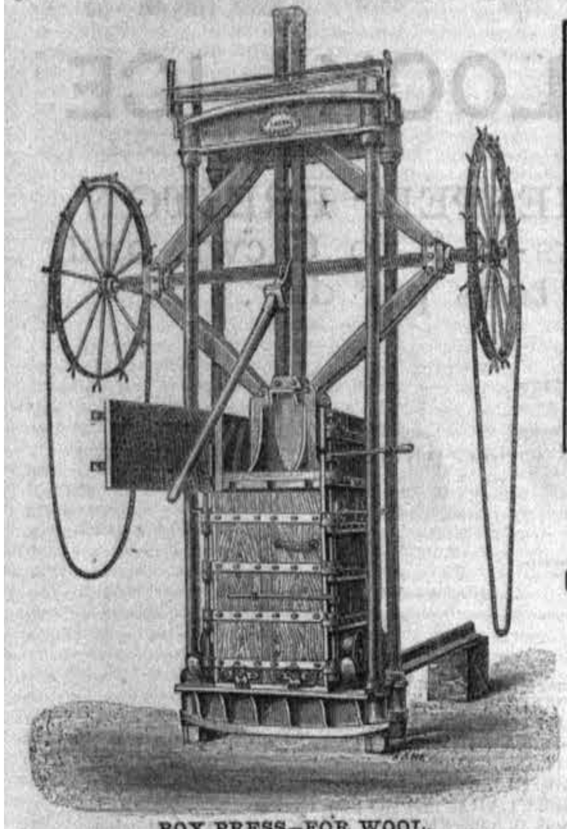
After a few remarks from Mr. Ellis,

The President said he did not intend to trouble them with many views of his own in respect to dephosphorising in which they were all so much interested. It seemed to him that the view taken by Mr. Holland was an absolutely correct view, namely, that if the chemical difficulties were got rid of the mechanical difficulty could not certainly interfere with the full development of the process. A great deal had been said of the good work done in America, and with regard to the quantity, there was no doubt that their American friends turned out more than they did. It had been said perhaps, that by turning out a less quantity there was more economy, but if that was the case, it was the first instance of the kind he had met with in any of his long experience. He could hardly point to an instance where a diminished quantity did not lead to a greater cost per ton, and where an increased quantity did not lead to a lower cost per ton. In this matter it would be perfectly possible for them to make up for lost ground and become on an equality with their friends. It had been said that the men in America were better than theirs, but he should doubt that part of the question. He was inclined to think that there was nothing in it. The whole question was to have machinery and appliances, enough blowing engines, &c., and when they had that they would make at any rate as large, if not a larger quantity as their American friends did. If it was really the case that they made a better quality article they had better maintain that advantage in addition. As regards dephosphorisation the mechanical difficulties had no doubt proved very much more formidable than any one expected, and their friends were meeting them in a way seeming to them best. No doubt it would have struck them that there was a wonderful difference of opinion as to the way to amend this matter. Mr. Pink had put it that if they got on to the larger vessels they would not do as well; but Mr. Richards thought that very much larger vessels still would be the cure altogether. He only hoped that before very long the question would be solved, and that the mechanical difficulties standing in the way of a great chemical success would very soon disappear altogether. Then they came to the question of mixing several brands of iron together for the purpose of producing an equality. As to that he was bound to say that he was a complete heretic. He did not think that the mixing of the brands must necessarily be an advantage; in fact, mixing an inferior article with a superior article must certainly be a disadvantage. The only question seemed to him was how to obtain with reasonable regularity a particular quality of iron they wanted. That could only be obtained in a large way by what he called judgment. No doubt analyses might be made frequently, which were now rapidly carried out and most useful as guides to manufacturers; but after all that was possible was done in that direction only a very minute portion of the iron could be tested. He was convinced, after a good deal of examination, and consideration and experience, that to obtain absolute uniformity of quality it must be by skill and careful and adequate furnace managing rather than by any other possible process. To begin with, proper furnaces and proper appliances connected with them, to be as careful as they could be that the best chemical assistance obtainable in the matter of materials was put into the furnace, and the workings of the furnace themselves would show exactly what they were going to have, and although it was still an unpopular form of belief he did not hesitate to declare his opinion that the safest and surest and most regular system possible was by working direct, and having for the management of their furnaces adequate skill and attention. In what had been mentioned that day there seemed to him that one very important suggestion had been altogether omitted, namely, the suggestion made by Mr. Holland, the transmission of the metal from one vessel to the other. He thought that being done very rapidly, as it undoubtedly would be done if they were to adopt the good advice of Mr. Walker, which was open to a little suspicion bacause he was a maker, and if they had adequate and sufficient machinery to take the iron from one vessel to the other as quick as possible and without any loss of time, he did not doubt that the suggestion that the iron should be desiliconised with an acid-lined vessel, and then removed to a bacic-lined vessel, would be a most efficacious one. It was a good practical mode of dealing with the material, and would no doubt become general. With these few remarks, which were not meant to be more than a mere casual statement of the opinions which had occurred to him, he would now close the discussion by asking the readers of the papers to be good enough to make such replies as they thought fit.

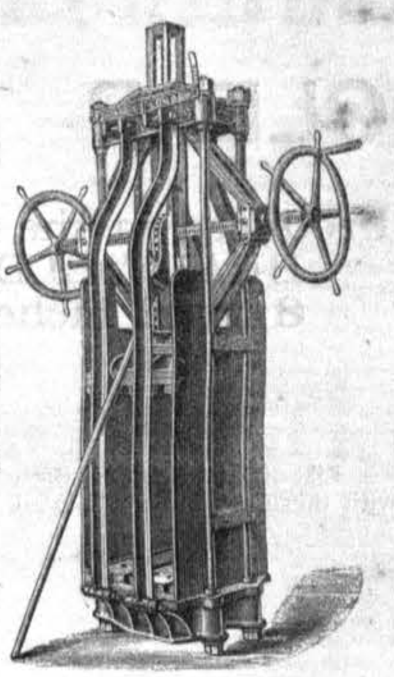
Mr. Pink said that no doubt they would be dissatisfied with him if he were to go on with this matter *ad libitum* and *ad infinitum*. Mr. Richards wanted to know how they had got the manganese into this pig-iron. This iron being sent to him at the last moment, before his departure from Westphalia, the data were not sent in, but he promised them that at their next meeting at Dusseldorf not

THE "BOOMER" PRESS,

ADOPTED BY H.M. GOVERNMENT.



BOX PRESS—FOR WOOL.
Made to any size and power required.

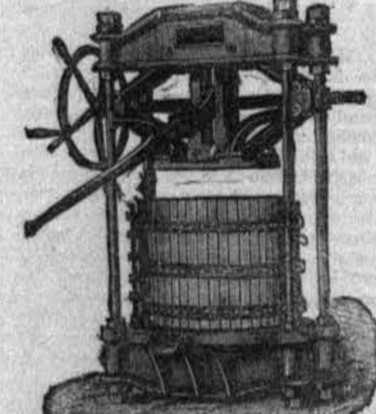


A.—WOOL DUMPING.

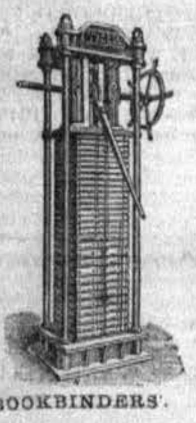
OVER 6,000 SOLD.

CAN BE WORKED READILY BY HAND TO A PRESSURE OF 300 TONS, AND BY POWER TO 600 TONS AND UPWARDS.

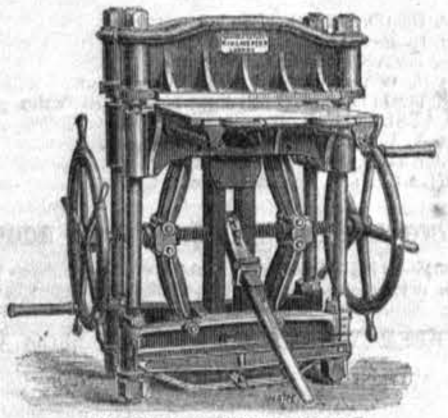
THE STANDARD OIL COMPANY
OF NEW YORK HAVE
150 "BOOMER" PRESSES
IN USE AT THEIR WORKS.



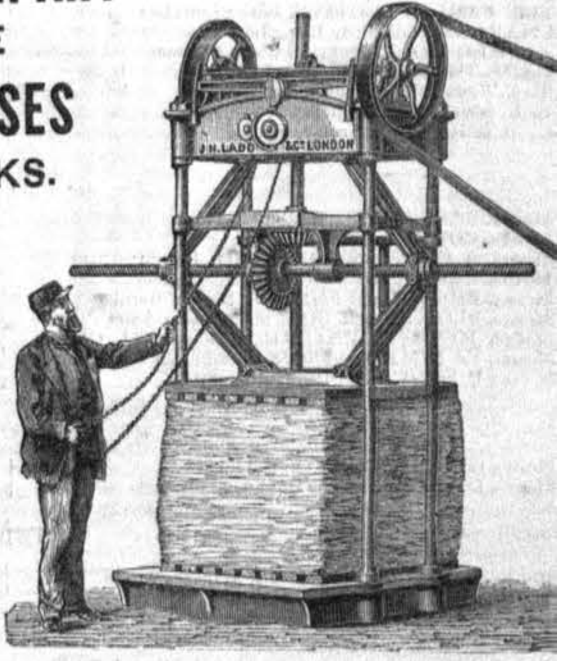
H.—No. 1, OIL AND HOOP.

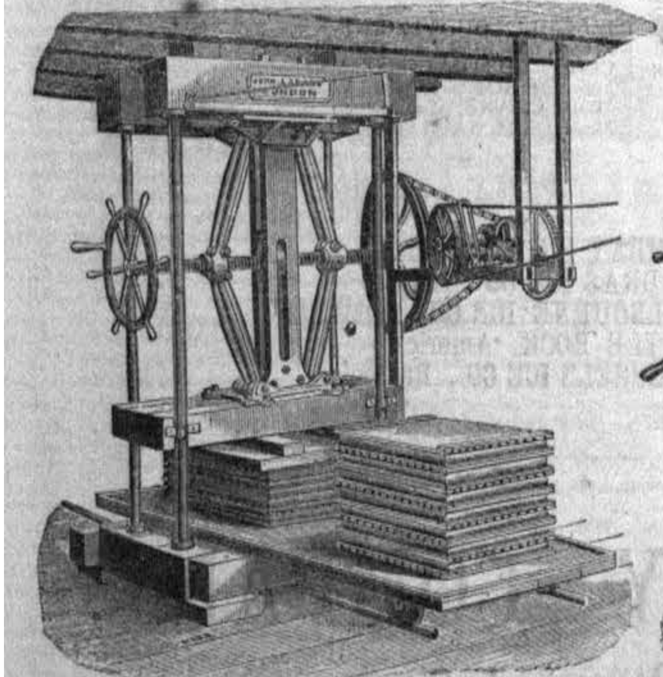


BOOKBINDERS'.

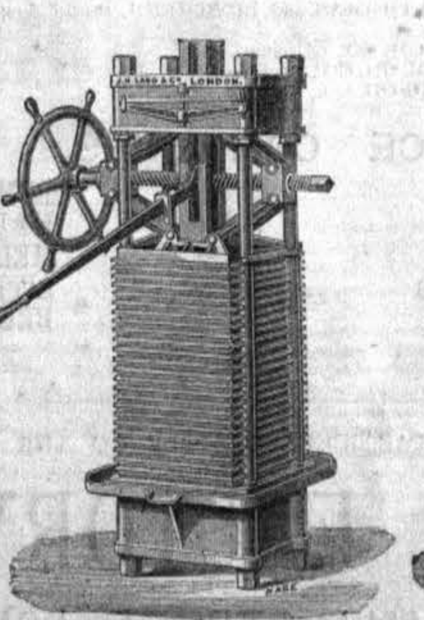


ELECTROTYPING PRESS.

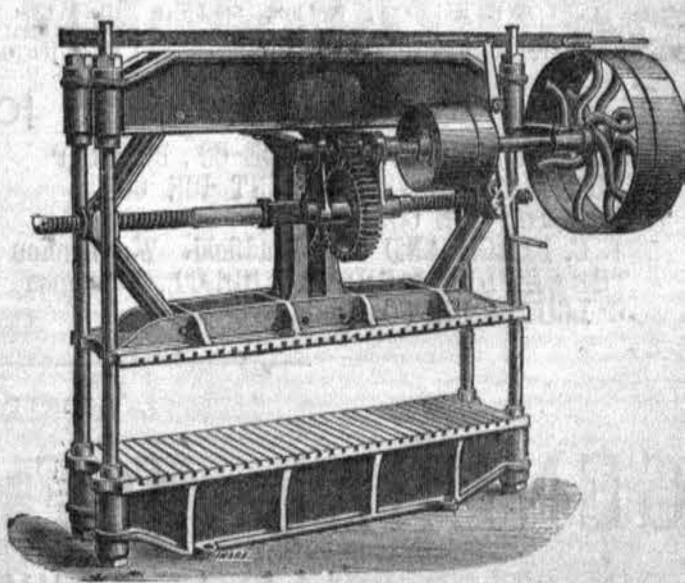




J.—CIDER or WINE PRESS, capacity 100 barrels per day.



OIL PRESS.



B.—FOR BUNDLING CLOTH, &c.

JOHN H. LADD & CO., 116, QUEEN VICTORIA STREET, LONDON, E.C.

SIDDELEY & MACKAY'S PATENT DIRECT-ACTING
ICE-MAKING AND REFRIGERATING MACHINES.

CLEAR HARD SOLID BLOCK ICE

Produced in the Patent Ice Factories of MANCHESTER, PRESTON, BRADFIELD and PENZANCE, in large blocks of 3 to 6 cwt. and 6 to 12 inches thick, in quantities of 2 to 30 tons per day.

List of Ice Factories, Breweries, Oil and Chemical Works, and Private Establishments in various parts of the World supplied with this Company's Patented Machinery, Apparatus and Appliances.

PRIVATE ESTABLISHMENTS.

THE MARCHIONESS of DOWNSHIRE, Wakebur Street
THE EARL of BECTIVE, Kirby Lonsdale
CHARLES FORBES, Esq., Java
ALFRED HOLT, Esq., for China Steamer
CAPT. THOMASON, R.E., India
T. T. BOND, Esq., Cawnpore
S. L. SMITH, Esq., Tunis
C. BURNUP, Esq., Seville, Spain

Mr. JOHN HILLIDGE, Preston
E. H. MACKAY, Esq., Queensland
STEPHEN BURK, Esq., of Rio de Janeiro
Messrs. CAPORN and BECKERLEY, Queensland
Messss. LAIDLEY, IRELAND and CO., for Fiji Islands
Messrs. LUKE THOMAS and CO., Aden
Messrs. RAPAYANNI and CO., for Syria
Messrs. FOWLER and CO., for Egypt
Messrs. BUDDEN, FISCHER and CO., London

Messrs. CLARK and CO., London
W. WALKER, Esq., London, for Batavia
G. SUTTON, Esq., Maryboro', Queensland
Messrs. LANDRE and GLENDERMAN, Amsterdam, for Java
Messrs. CLEOTE and FULLERTON, for Cape Town
Messrs. CLARK and CO., for Ceylon
Messrs. WARNER, WALDUCK and CO., for Ceylon

BREWERIES.

Messrs. BASS and CO., Burton-on-Trent
Messrs. COMBE and CO., London
Messrs. A. GUINESS, SON and CO., Dublin
Messrs. BAKER and SON, Heavitree, Exeter
Messrs. BROWN and ASTLEY, Nelson, Burnley
Messrs. FLOWER and SON, Stratford-on-Avon
Messrs. JOWETT, WATERHOUSE and CO., Oldham
Messrs. W. NIMMO and SON, Castle Eden
Messrs. P. and R. PHIPPS, Northampton

Messrs. REID and CO., London
Messrs. H. ROBINSON and CO., Wigan
Messrs. EVANS and CO., Wrexham
Messrs. P. WALKER and SON, Warrington
Messrs. TOOTH and CO., Sydney, New South Wales
B. GARTSIDE, Esq., Ashton-under-Lyne
Messrs. A. WALKER and CO., Liverpool.
R. BLEZARD, Esq., Manchester
D. I. FLATTELY, Esq., Manchester

A. STROPFORD, Esq., Manchester
P. WALKER, Esq., Wrexham
I. J. WILKINSON, Esq. (late Pinder and Co.), Exeter.
Messrs. H. C. WILSON and CO., Manchester
— BENTLEY, Esq., Manchester
Messrs. J. I. MURPHY and CO., Dublin
Messrs. J. D'ARCY and SON, Dublin

COOLING AIR IN CHAMBERS AND ROOMS.

Messrs. GUINNESS and CO., Dublin
Messrs. D'ARCY and CO., Dublin

Messrs. WATKINS and CO., Dublin
Messrs. WHITELEY and SONS, Halifax

MARQUES DE SOUZE, Rio de Janeiro

INDIARUBBER WORKS—Condensing Naphtha Vapours.

Messrs. D. MOZELY and SONS, Manchester

Messrs. WHITELEY and SONS, Halifax

Messrs. WALTON and CO., Woodly

OIL AND CHEMICAL AND OTHER WORKS.

Messrs. YOUNG'S Paraffin, Light and Mineral Oil Co., Glasgow
Messrs. P. MOIR, CRANE and CO., Oil Works, Manchester
Messrs. C. LOWE and CO., Reddish, Stockport Chemical
Mr. GRAESSER, Ruabon

Messrs. CHEETHAM, DUNKERLEY aad Co. Manchester Chemical Works
Messrs. C. THOMAS and BROTHERS, Bristol Soap Works
UPHALL OIL CO., Glasgow
OAKBANK OIL CO., Glasgow
STANRIGG OIL CO., Glasgow

BUXBURN OIL CO., Glasgow.
Messrs. McCLURE and CO., Glasgow
CLIPPENDS OIL CO., Glasgow
Messrs. J. SIMPSON'S Oil Works, Edinboro'
MOIR CRANE, Manchester
Messrs. S. H. GARTSIDE and CO., Ashton-under-Lyne

ICE COMPANIES.

KENT & SUSSEX PURE ICE CO., Brighton
THE MANCHESTER PATENT ICE CO.
PRESTON ICE CO.
J. C. BERGE AND CO., Bradfield, W. London
THE NEWLYN & GULVAL ICE CO., Penzance
CALCUTTA ICE CO., India

BOMBAY ICE CO., India
MADRAS ICE CO., India
MELBOURNE ICE CO., Australia
LITTLE ROCK, America
BRUSSELS ICE CO., Brussels

FOR PARTICULARS APPLY TO THE

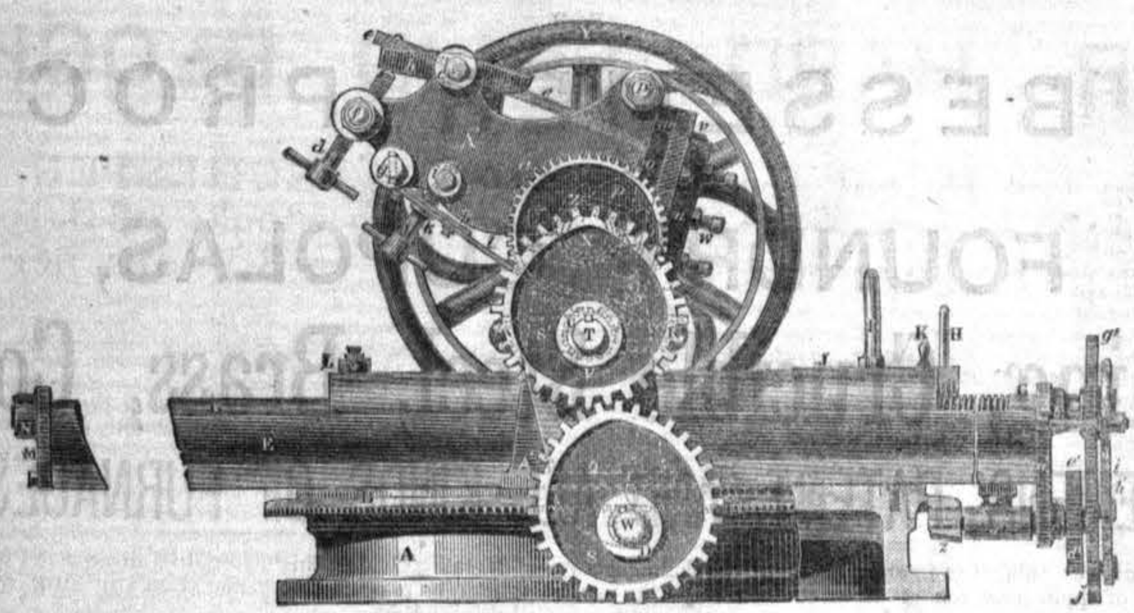
GENERAL ICE FACTORY COMPANY,

144, LEADENHALL STREET, LONDON, E.C.

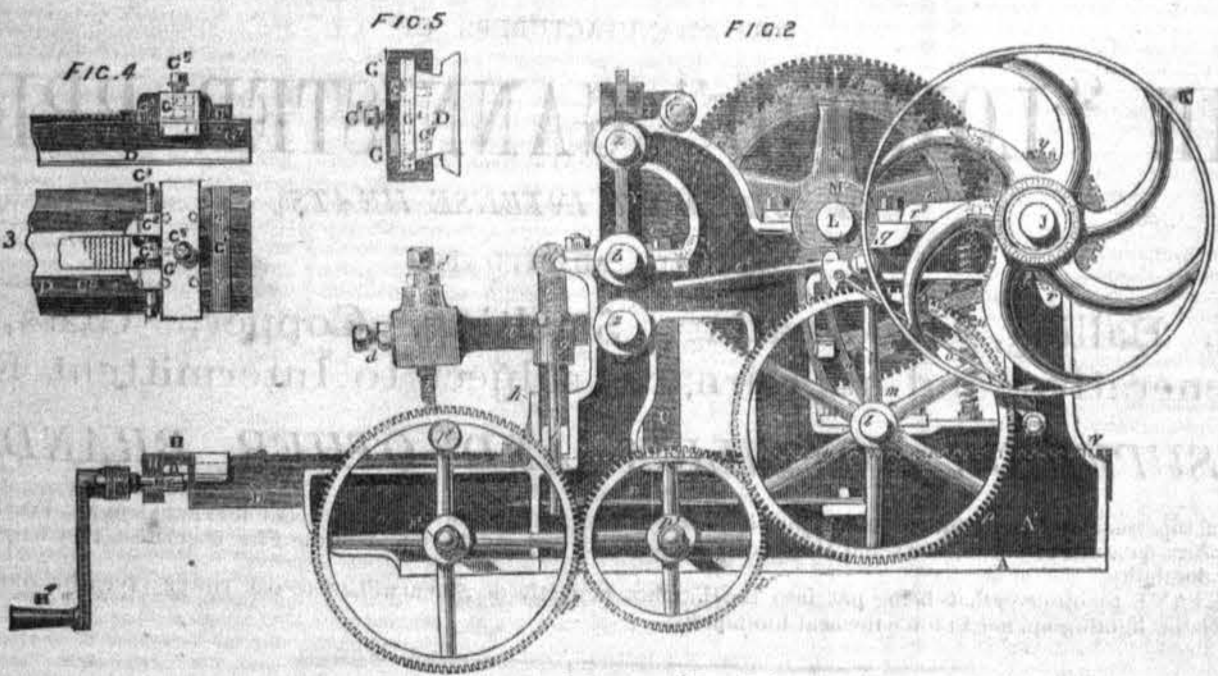
Contractors for this Patent Ice Plant for all parts of the World.

FOR SALE OR BUSINESS ARRANGEMENT.

FILE & RASP CUTTING MACHINES.



File Cutting Machine.



Rasp Punching Machine.

THE PATENT RIGHTS OF THESE MACHINES,

Taken Out in January, 1878, are now Offered.

For Full Illustrated Description see "IRON," November 7th, 1879.

All Particulars on Application to

T. W. LEE,

2, PANCRAS LANE, QUEEN VICTORIA STREET, E.C.,

Who will also arrange to show the Machines in operation if desired.

J. GRAYSON LOWOOD AND COMPANY,

MANUFACTURERS OF

GROUND GANNISTER,

FOR

THE BESSEMER PROCESS,

AND FOR LINING

FOUNDRY CUPOLAS,

Puddling, Crucible Steel, Brass, Copper,

SIEMENS' PATENT, AND ALL KINDS OF FURNACES.

As a lining for all Furnaces, subject to intense heat and the fluxing action of Metallic Oxides, this material is unsurpassed in Refractory power and durability, whilst its ease of application renders it most economical in use, being merely plastered or rammed TO THE SIDES of the Furnace over the Brick or Stone lining.

SOLE MANUFACTURERS OF

THE "LOWOOD" GANNISTER BRICK,

(*FOR THE MOST INTENSE HEATS*)

SPECIALLY ADAPTED FOR

Puddling, Balling, Re-Heating, Smelting, Copper, Glass, Siemens' Regenerative, and all Furnaces subject to Intermittent Firing.

SUPERIOR TO SILICA AND OTHER BRANDS.

These Bricks supersede the usual Silica Brands for Siemens' Furnaces, being more refractory and less EXPANSIVE. For building the CROWNS, BACK WALLS, BRIDGES, &c., of PUDDLING, MILL and HEATING FURNACES, and where the action of the Fire is greatest, they have proved themselves to be unparalleled for durability.

It is IMPORTANT to observe, that being put into the Furnace perfectly dry, they will wear out THREE LIVES OF ORDINARY FIRE BRICKS. Care should be taken, on lighting up, not to force the heat too rapidly.

ALSO SOLE MANUFACTURERS OF

LOWOOD'S CELEBRATED

STEEL MOULDERS' COMPOSITION,

For Bessemer and Crucible Steel Castings, Cores, &c.

This article is used for making the Moulds for Steel Castings, Cores, &c., instead of the ordinary MOULDING SAND, and being more refractory, will resist the severe action of the Molten Steel better than any other material, and is celebrated for producing a CLEAN and SMOOTH surface to the casting.

It is supplied to almost all the large Steel Works in the kingdom.

Works:—ATTERCLIFFE ROAD, SHEFFIELD,

AND

DEEPCAR, M. S. & L. RAILWAY SIDINGS, NEAR SHEFFIELD.

Shipping Ports—Hull, Grimsby, Liverpool and London.

PLEASE ADDRESS ORDERS AND CORRESPONDENCE TO OFFICES, ATTERCLIFFE ROAD, SHEFFIELD.

THE IRON TRADE OF THE CONTINENT IN 1879.

INTRODUCTORY.

ENGLISH men of business belong, as practical economists, to one of three great schools of industrial economy. They are optimistic, and believe in the actual or potential manufacturing ascendency of Great Britain; or they are pessimistic, and have fears for the prosperity of English trade; or they are rationalistic, and take things as they find them. To whichever of these divisions our readers choose to refer themselves it seems to us that they equally stand in need of information as to the position held by Great Britain relatively to other manufacuring powers. With detailed information in hand as to foreign trade, the optimist will be able to say how small that trade is, the pessimist how large it is, the neutral man what it is. It is not our intention here either to state or defend any specific set of industrial doctrines. We will content ourselves with recalling to our readers, as we have on former occasions, the phenomenon of the extension of the iron trade on the Continent of Europe in spite of many conditions adverse to its prosperity, and the change of manufacturing relations between England and the Continent which has taken place during the last fifty years. Every one feels that competition is keener, although, as yet, every one does not realise the unceasing necessity there exists for his being on the alert. The common intelligence of the iron trade does, however, confess to a need of acquiring and diffusing information on technical points; and the meetings of the Iron and Steel Institute—the foundation of the Institute itself—are due to a keen sense of the necessity of following on the track of technical progress, which is a purely modern development, traceable to the sense of a common danger. The half-yearly meetings of the trade, at which its general position is brought under review, are a testimony to the fact that British ascendency in the iron trade—the surly, strenuous independence of its individual members—is a thing of the past.

In its creation of a foreign secretaryship the Iron and Steel Institute has also given in its adherence to the doctrine *fas est et ab hoste doceri*, which we preach every week under the rubric "Continental Mining and Metallurgy." But since the death of Mr. Forbes the Institute has not, we think, been kept so fully and punctually informed as it might have been on the technical and manufacturing progress achieved on the Continent. The report presented by its foreign secretary to the Institute at its spring meeting in 1878 was certainly far from perfection;* and from the fact that no sequel to that report has appeared, it may not be unfair to argue that its author confesses his inability to repair his failure. In our number for Nov. 9, 1878, *apropos* of Mr. Pechar's very valuable contribution to the literature of the iron trade, we laid down the basis of such a manual of coal and iron as would have been of the highest possible service to the members of the coal and iron trades. Since that was written Mr. Jeans' laborious compilation "Steel" has in part given satisfaction to our previsions: the more fugitive features of our own plan we have endeavoured to carry out for ourselves, in the reports which we now have the pleasure to present to our readers. "The compilation of some such complete manual of coal and iron would very fitly be undertaken by the Iron and Steel Institute," we wrote in November, 1878; "which would have in the principal iron-producing countries of the world various correspondents—geological, statistical, metallurgical, mechanical, economical—whose information would be fresh, various and valuable." It was not within our means to employ a variety of correspondents in reporting for us in this departmental manner; our coadjutors have had to double their parts; but we have ourselves adopted the principle of a division of labour. Acting under the conviction that properly authenticated information on Continental trade has a real value for English iron and forge masters, we made arrangements for procuring a set of reports on Continental trade during 1879. The best way to ensure the authenticity of each report was to engage the services of writers known to be authorities in each country reported on. Not only was greater fulness and accuracy to be expected, but it was of some importance to avoid the monotony of style inseparable from single-handed compilation, and it was of some advantage to see the facts proper to each country as they present themselves to the collective mind of each country.

Thus the support was obtained of the following gentlemen, whom we have much pleasure in introducing to our readers:—For Belgium, M. Max Goebel, of Liége, editor of the *Semaine Industrielle*, a well-known technical Belgian journal, and author of the section on Belgium contained in Mr. Pechar's excellent "Coal and Iron;" for Sweden Professor Richard Åkerman, of the Royal School of Mines Stockholm, an old and tried friend to whose reputation it is not in our power to add; for Austria to Freiherr von Lindheim, of Vienna, whose finished monograph, "Eisen und Kohle im Welthandel" preceded Mr. Pechar's book; for France, to M. Francis Laur, of Saint-Etienne, a mining engineer whose journalistic duties have made him acquainted with the literature of his profession; for Spain, to Senor Don José Alcover, of Madrid, proprietor and editor of the *Gaceta Industrial*, a patriotic Spaniard whose earnest desire to see the iron trade of Spain enter upon a period of self-development has led him to the collection for his own purposes of information relative to that trade. For their courtesy and painstaking, our best thanks are due to these gentlemen, and those of our readers will not, we hope, be refused.

It seemed to us desirable that certain data should be furnished, for the sake of comparison, from each country. A brief tabulation would then have given at one view the principal results, side by side, yielded by each country, so far as they admitted of expression in figures. Our hopes of carrying out a scheme of comparative tabulation have, however, been frustrated, partly by the lateness of arrival of some of the reports, and partly in consequence of the total defection of our German and Austrian correspondents. In justice to the latter gentleman, however, we should state that as we were going to press we received a telegram from him in which the non-receipt by us of his report is accounted for by his sudden illness. As soon as the document is received by us we shall publish it in our journal.

Let us frankly acknowledge that we are aware of shortcomings, both in the conception and execution of our plan. We shall not shrink from criticism, and we shall not be ungrateful for any suggestion tending to render our plan less imperfect. But we claim the merit of being the first to show in practice how the task of throwing open cotemporary Continental industry to British view is best accomplished, and members of the iron trade who have visited Creusot, Seraing, or Westphalia, will be able to judge whether or not the task was worth attempting.

BELGIUM.

By MAX GOEBEL, Liége.

BELGIUM occupies an area of 11,372 square miles, and its present population is estimated at five and a half millions. The total number of mining grants is about 100; they give the right of extracting minerals of various kinds over a surface of 60,000 hectares, or 225 square miles. About 3000 hands are engaged in them on 37 distinct sites. All these workings are underground. Owing, however, to a defect in the mining law, which has omitted to legislate for the transferability of iron ore in underground deposits, ironstone mines form but a small number of the above total of mining grants. No grant of right to work an ironstone mine having been made since the separation of Belgium from Holland in 1830, the total amount of ironstone won in Belgium is got from the so-called free workings, or *minières*. These are 170 in number, 125 of them being underground; they employ 1300 hands, and produce annually 250,000 tons of ironstone. The output, both from the *mines*, properly so called, and the *minières*, has considerably diminished during the past ten years—the cause of the shrinkage being chiefly found in the growing use of Luxembourg minettes, the disabilities of concession under which Belgian ironstone mines lie tending in the same direction.

The ironstone extracted in Belgium consists of specular iron ore, bog ore, and clay ironstone.

The following table will show how the output of ironstone in Belgium has declined during the past twenty years:—

Year.	Output.		Import.		Export.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£
1860	809,176	309,944	1,486	1,600	152,144	131,640
1865	1,018,231	373,180	301,846	724,440	230,539	211,320
1867	602,829	237,840	322,891	348,720	152,227	109,600
1868	519,740	190,034	396,282	428,000	136,067	97,960
1869	628,046	228,358	551,900	596,040	164,576	98,760
1870	654,332	232,216	568,571	614,040	179,867	107,920
1871	697,272	253,507	594,405	641,960	162,566	97,420
1872	749,781	295,618	790,593	853,840	178,997	121,720
1873	503,565	240,891	739,541	798,720	215,042	146,240
1874	527,050	206,947	738,835	491,080	109,114	61,120
1875	365,044	136,924	804,370	643,580	141,767	79,400
1876	269,206	98,320	671,134	536,920	166,418	93,200
1877	234,227	86,316	783,322	626,640	216,747	121,360
1878	—	—	833,622	666,880	240,903	134,920
1879	—	—	614,534	—	189,127	—

It is not without interest to give the sources whence Belgium imports ironstone and the quantities respectively drawn from each source. The following figures give the imports for the past three years:—

	1879.	1878.	1877.
	tons.	tons.	tons.
Prussia	82,201	72,389	59,135
Grand Duchy of Luxembourg	447,615	632,160	573,600
Holland	11,418	9,519	10,334
France	55,433	71,206	63,992
Spain	13,016	32,675	55,375
Algeria	4,780	15,653	16,229
Other countries	71	20	4,657
	614 534	833,622	783,322

The reader will easily guess the uses to which these various ores have been applied.

We have no positive information as to the internal production of ironstone in Belgium during the past three years; supposing it to have remained at its previous level, it will appear that Belgium is consuming less ironstone—the imports during that period having declined very seriously. Less pig, therefore, must have been made than used to be.

The Luxembourg minettes, which form more than two-thirds of the bulk of the ore smelted in Belgian furnaces, are of three kinds: red mine with siliceous gangue, the same with calcareous gangue, and grey mine, also generally accompanied by a calcareous gangue. The content of metal in them varies from 28 to 35 per cent. The following is an analysis of samples of the three varieties:—

	Red calcareous minette from Esch.	Grey calcareous minette from Ottange.	Siliceous minette from Ottange.
Silica	8·0	7·5	31·5
Alumina	3·8	3·1	4·5
Limestone	10·0	16·1	2·5
Magnesia	0·4	0·6	0·1
Ferric oxide	49·5	42·0	41·0
Manganoso-manganic oxide (Mn_3O_4) ..	0·4	0·2	0·4
Phosphoric acid ..	1·6	1·5	1·2
Carbonic acid	8·4	13·5	2·0
Water	18·0	15·5	16·8
	100·1	100·0	100·0
Iron	34·7	29·4	28·7
Phosphorus	0·70	0·66	0·53
Manganese	0·25	0·14	0·28

Added to most of our ores the minettes improve the quality of the smelted product. The iron got is mild, easy to work, and looks well when worked up. The resistance to traction varies, according to the combustion of the charge, from 32 to 36 kilogrammes per square millimetre, with an elongation of from 4 to 6 per cent.

In 1865 the Ougrée Ironworks Company commenced to make spiegeleisen by the addition of manganesiferous ores to good Belgian ironstones. The pig produced contains 5 to 6 per cent. manganese, and 0·50 per cent phosphorus; it is free from sulphur and is less highly carburetted than grey pig.

As a rule, before charges are made up for the furnace in Belgium, the ironstone used is subjected to chemical analysis, the mixtures are carefully and precisely made, and the smelted product comes out of uniform quality. The following are the types of forge pig commonly made and put on the market in Belgium:—Spiegeleisen or manganesiferous pig for fine-grained irons; good forge pig, with 1½ to 2 per cent. phosphorus, for puddling purposes or superior castings; common forge pig, containing 2 to 2½ per cent. phosphorus; and in the last place cinder pig, which contains 3 per cent. phosphorus or even more.

The prices got for pig-iron in late years are shown in the following table, which gives the Ougrée quotations averaged each year for each class of pig:—

	Common forge pig. Per ton.					Spiegeleisen. Per ton.				
	fr.		£	s.	d.	fr.		£	s.	d.
1873	126·20	=	5	0	2	181·90	=	7	4	3
1874	86·20		3	8	6	144·90		5	15	0
1875	81·70		3	4	10	125·50		4	19	7
1876	68·80		2	14	8	109·00		4	6	4
1877	63·00		2	9	10	98·50		3	18	3
1878	61·50		2	8	10	92·50		3	13	4

In 1879 forge pig came down further 4 fr. 80 (3s. 10d.), and steel irons 11 fr. 60 (9s. 3d.)

The manufacture of foundry pig in Belgium is declining: it is restricted now to the province of Hainault. The foundry pig made in the district of Charleroi comes in quality between Cleveland and Scotch pig. Its price follows the quotations of English exchanges, and this branch of Belgian industry would probably undergo a complete displacement were it not supported by the 5 fr. (4s.) duty levied by the Belgian custom house on foreign pig.

Belgian blast-furnaces are generally from 17 to 18 metres (say from 56 to 60 feet) in height; the capacity of the stack varies from 37,000 cubic feet to 10,500 cubic feet (200 to 300 cubic metres). Whitwell and Cowper apparatus are generally made use of for heating the blast. A few years ago the Sclessin Company built two furnaces of very large capacity, each being provided with four Whitworth stoves. The height of these furnaces is 20 metres (65 feet 6 inches) each; diameter at the boshes 7 metres (23 feet); they work with a blast heated to 600 to 650 centigrades. The make at Sclessin reaches from 100 to 120 tons per twenty-four hours.

---

* See the article headed "Foreign Intelligence" in No. 281 of IRON, June 1, 1878.

Still more recently the Monceau-sur-Sambre Company has built a furnace of a capacity of 210 cubic metres (7500 cubic feet); the blast being heated in a Cowper-Siemens furnace. Forge pig is made, the yield of which is 80 tons per twenty-four hours. In 1879 this company made 27,132 tons of metal with a single furnace. The following table will show the make of Belgium as well as her imports and exports from 1850 to the present time:—

Year.	Make.	Furnaces, on Blast	Imports.	Exports.
	tons.		tons.	tons.
1850	144,452	41	—	92,345
1860	319,943	51	725	22,086
1865	470,767	56	24,864	10,711
1867	423,069	—	53,385	11,062
1868	435,754	—	42,549	16,525
1869	534,319	—	61,600	14,266
1870	565,234	48	82,330	10,176
1871	609,230	49	84,299	48,526
1872	655,565	52	137,008	49,096
1873	607,373	54	145,212	27,208
1874	532,790	55	158,291	16,188
1875	540,473	42	146,886	15,672
1876	490,508	31	207,264	9,479
1877	470,488	28	184,212	11,816
1878	493,544	28	207,217	5,412
1879	—	—	194,291	36,465

The year 1878 is the last for which we possess any authentic statistics of the make of pig-iron in the various iron-producing districts. In 1878 the province of Liége possessed 19 furnaces, 11 of which were on blast the whole of the year, the outturn being 117,916 tons of forge pig, worth in all £274,824; 54,164 tons of hematite pig, worth £176,507; and 342 tons of foundry pig, worth £1600. In the province of Hainault there were in the same year 44 furnaces, 15 of which only were on blast. The make was 245,777 tons of forge pig and 19,580 tons of foundry pig. The province of Belgian Luxembourg has at Athus, near the frontier of the Grand Duchy, two furnaces on blast, which in 1878 made 55,765 tons of pig, half forge half foundry, of the total value of £116,000. All together, out of 65 blast furnaces in Belgium there were in 1878 only 28 on blast, the same number as in 1877. This number remained the same to the end of 1879.

The production of pig for steel making is confined to the province of Liége. Leaving out of account the spiegeleisen made by the Ougrée Ironworks, which is mostly worked up into fine-grain irons and puddled steel, the monopoly of the manufacture of Bessemer pig in Belgium is in the hands of the Cockerill Company at Seraing. This company began making steel in 1862, but up to 1874 followed the English method of remelting in the cupola or reverberatory furnace. Since the date last mentioned the Cockerill Company has acquired mining rights in foreign ironstone mines, and it now conveys the smelted material direct to the converter. In 1878 the company made 115,579 tons of Bessemer ingots, worth £502,070. Quite lately the Sclessin Ironworks, which some years ago used to manufacture steel by the Siemens-Martin process, has begun to make pig suitable for conversion by the Thomas-Gilchrist process, by eliminating as far as possible the sulphur which is found in native ironstone.

The efforts which have been made to replace hematite pig from England by native-made pig fit for treatment by the Bessemer process have not had all the success which might have been expected from them. The accompanying table will, however, show that the imports from England are steadily declining:—

IMPORTS—PIG AND SCRAP.

	1879. tons.	1878. tons.	1877. tons.
From			
Sweden and Norway ..	1,511	1,625	1,035
Prussia	44,302	38,366	33,200
Luxemburg (Grand Duchy)	58,943	67,799	59,840
Holland	22,116	29,499	13,422
England	66,606	69,148	75,379
Other countries	814	779	1,336
	194,292	207,216	184,212

EXPORTS—PIG AND SCRAP.

	1879. tons.	1878. tons.	1877. tons.
To			
Prussia	2,747	326	402
Luxemburg	484	86	50
Holland	536	86	1,026
England	66	444	915
France	3,264	3,352	7,632
Switzerland	611	1,071	1,472
United States N. A. ..	28,262	—	111
Other countries	495	47	210
	36,465	5,412	11,818

It should be mentioned here that the Custom House returns, from which the above figures are taken, do not discriminate between pig and scrap. This confusion, however, is of small consequence except as far as regards Holland.

The manufacture of iron properly so called has been declining rapidly in Belgium since 1872. The last official statistics published do not come down beyond 1878, and they are scattered through single reports relative to the various industrial districts of the country. In 1877, when the crisis had not attained its apogee, the make had fallen to 378,553 tons from 500,000 tons in 1872. The money value of the make in 1877 was £2,400,000, against £4,960,000 in 1872 and £5,560,000 in 1873.

The furnaces invented in different countries with the object of substituting mechanical for hand labour, in puddling have not given satisfactory results. The most noteworthy innovation introduced of late years into Belgian ironworks is the Bicheroux furnace, the use of which is spreading. The Ougrée Ironworks Company tried the system in 1872 for its reheating furnaces, and shortly afterwards applied it to its puddling furnaces. So far the saving in fuel, and labour and the decrease of waste have been very considerable. The example of the Ougrée Company has been followed by the Châtelet, and Centre Rolling Mills, by MM. Dupont-Defoys and Bonehill, by the Acoz Forge Company, and others, and finally the Bicheroux furnace has been adopted for the steel furnaces at Seraing.

The following figures show the number, plant, and make of Belgium ironworks, for 1877:—

	Brabant.	Hainault.	Namur.	Liége.	Total.
No. of works	2	30	5	16	54
Refinery hearths	—	—	5	1	6
Furnaces—puddling	29	514	44	191	778
reheating	9	193	15	122	339
Squeezers, &c.	2	21	—	4	27
Steam-hammers	5	54	11	35	106
Tilt hammers	2	7	—	2	11
Shears and saws	11	133	2	69	215
Rolling trains—blooms	4	36	2	25	67
merchant irons, heavy profiles ..	2	29	1	11	43
ditto, light profiles	3	34	1	11	49
rails	—	10	2	4	16
plates	3	10	—	25	38
split irons	—	14	—	1	15
Steam-engines	26	344	18	219	607
h.-p. of ditto	884	10,228	550	5,547	17,209
Water wheels	1	3	8	11	25
h.-p. of ditto	15	115	76	332	548
Hands	872	6,690	809	3,363	11,737
Make, all classes of iron (in tons)	14,612	234,314	33,721	95,841	378,553

Of the 2 ironworks in Brabant 1 was closed in 1877, as were 5 of those in Hainault. Of the 29 puddling furnaces in Brabant 14 were laid cold, and 218 of those in Hainault, 3 of the Brabant reheating furnaces were laid cold and 97 of those in Hainault. The total make of iron is decomposed into 59,474 tons rails, 52,504 tons sheet, and 266,575 tons profile irons, the average prices of which were respectively £5 19s. 4d., £8 9s. 6d., and £6 1s. per ton.

During the past few years considerable additions of mill machinery have been made to the plant existing in Belgian works. The new rolling trains introduced are carefully finished, nicely fitted and solidly put up. Each train takes its power from a special engine, so that the speed can be regulated according to the dimensions of the iron to be rolled. In trains for small profiles the power is taken from driving bands. Most of our profile irons are manufactured in three-high rolls. Several mills have adopted the train known as Lauth and Deby's trio, and have no reason to be dissatisfied.

The rolling mills of Belgium have been well able to withstand the general crisis, as well as the minor one caused by the substitution of steel rails for iron. The exports of forged, drawn, and rolled iron reached in 1879 the same dimensions as in 1872, and surpassed those of 1873, although the weight of iron rails exported fell from 72,942 tons in 1873 to 29,596 tons in 1879. The falling off in rails has been entirely made up by the increased business done in plates, and special and merchant irons.

MANUFACTURED IRON—BARS, BLOOMS, PLATES, RAILS, &C.

Year.	Make.	Imports.	Exports.
	tons.	tons.	tons.
1868	328,295	3,517	156,307
1869	468,565	5,806	240,386
1870	491,563	5,518	219,727
1871	467,210	4,673	186,922
1872	502,577	14,989	210,043
1873	580,374	18,177	181,661
1874	510,920	20,611	227,450
1875	436,440	9,671	182,668
1876	399,138	8,887	166,161
1877	378,553	9,504	174,409
1878	—	8,411	193,138
1879	—	8,677	210,786

In 1877 there were 53 works in Belgium in which iron was wrought into shape, and 178 foundries. The latest data concerning these two branches of metallurgy are contained in the following tables:—

MALLEABLE IRONWORKS.

	Brabant.	Hainault.	Namur.	Liége.	Luxembourg.	All Belgium.
Number	3*	25†	4	19	2	53
Reverberatory furnaces ..	2	32	—	—	—	34
Heating furnaces	5	82	6	77	3	180
Rolls	—	1	—	27	—	28
Tilt and steam hammers ..	3	32	4	11	—	50
Planishing hammers ..	—	15	1	3	1	20
Wire mills	1	—	—	3	1	5
Steam-engines at work ..	3	22	—	10	—	35
" h.-p. ..	24	346	—	148	—	158
Water wheels	2	37	8	31	2	80
" h.-p. ..	12	400	82	592	21	1,167
Hands	30	420	17	523	24	1,014
Make—tons	436	4,807	251	13,609‡	202	19,305

* 1 closed † 2 closed. ‡ comprising 7232 tons of plates.

IRON FOUNDRIES.

	Brabant	Hainault.	Namur.	Liége.	Luxembourg.	All Belgium.
Number	2	91*	29	48	8	178
Reverberatory furnaces ..	—	3	—	4	—	7
Cupolas	4	155†	33	72	10	274
Steam-engines	2	68	23	40	4	137
" h.-p. ..	25	569	128	320	25	1,067
Water wheels	—	—	1	2	4	7
" h.-p. ..	—	—	12	25	26	73
Hands	245	1640	299	1,910	80	4,174
Castings—tons	3230	40,104	4,682	29,236	815	78,067

* 10 closed. † 54 cold.

The number of malleable ironworks, after remaining stationary from 1868 to 1872, both inclusive, has since the latter year undergone a considerable diminution; and the weight of make, together with its value, are only now beginning to come up again to the level of the weights and values of ten or twelve years ago. With the foundries it is different; their number and their productive power rose steadily till 1875, and has fallen back only a little from that year. Considering exports merely, the exports of wrought iron and castings have gained more than 40 per cent. during the last ten years.

We have already stated that the steelworks of Belgium are concentrated in the single province of Liége. These establishments used to be three in number—the Cockerill works at Seraing, and the Société anonyme des aciéries d'Angleur, manufacturing Bessemer metal; and the Sclessin Company, which used to make Siemens-Martin metal. The latter no longer concerns itself with the manufacture of steel, so that there are in Belgium at the present time only two steelworks. "The future," says M. van Scherpenzeel-Thim, "belongs entirely to the Bessemer process, and this assertion is especially true since the dephosphorisation of pig in the converter seems to be a problem which has received its solution." At the time this prophecy was uttered, no trial of the invention of Messrs. Thomas and Gilchrist had been made in Belgium.

It was not till the end of 1879 that the Angleur Steelworks made experiments which have been crowned with a complete success. This company has acquired Mr. Thomas's patent rights for Belgium, and last November finished fitting one of its converters with a basic lining. We have no need here to dwell upon the good fortune which the acquisition of Mr. Thomas's patents has assured to the Angleur Steelworks Company. Instead of being compelled to depend for its raw material almost exclusively on supplies from the north-west of England, paid for at a high rate at first, compelled to bear the cost of carriage, of assurance, and of transhipment at Terneuzen or Antwerp, and loaded with an import duty of 4s. per ton if meant for home consumption, the Angleur Company will be able to draw from the neighbourhood of its own works, from Belgian Luxembourg (Athus), or the Grand Duchy—that is to say, at its very doors,—supplies of pig, the initial cost of which is small, while it is converted in works surrounded by a belt of collieries at the hands of workmen who are esteemed to be some of the most skilful practical metallurgists in the world.

The make at Angleur, by the old process of remelting, was 32,919 tons in 1878-9, or 4000 tons more than in 1877-78, the items of make standing as follows for those two years:—

	1878-9.		1877-8.
	tons.		tons.
Rails	26,345	..	23,067
Tires	3,745	..	3,351
Forgings	1,274	..	1,920
Rolled goods	1,517	..	379
Castings	37	..	197
	32,919		28,914

The last report of the Angleur Steelworks Company brings into very clear contrast the economical conditions of making Bessemer steel in Belgium on the English system, and those of making it by dephosphorising in the converter. The consumption of grey pig, manganese pig, and ferro-manganese by the Angleur Company during its last business year 1878-9 was 39,500 tons, at an average price of 87 fr. 65 c. (£3 9s. 6d.), against 35,524 tons, costing on an average 94 fr. 32 c. (£3 14s. 9d.) in 1877-8. In 1876-7 the average amount paid per ton for pig was 103 fr. 66 c. (£4 2s. 4d.)

We have gone at length into these points from the importance they possess relatively to the future. At the time of writing, the Cockerill works at Seraing own two-thirds of the Bessemer converters which exist in Belgium.

The following are particulars of the make and imports and exports of steel:—

Year.	Make.	Imports.	Exports.
	tons.	tons.	tons.
1868	2,510	3,195	289
1869	5,420	4,256	434
1870	9,563	5,436	853
1871	8,900	9,673	4,519
1872	15,284	15,196	2,703
1873	19,056	17,395	4,321
1874	20,953	10,189	5,234
1875	47,200	5,342	7,319
1876	75,258	6,137	5,567
1877	84,861	4,915	18,237
1878	95,000	4,982	37,057
1879	—	4,505	46,958

Details of general metallurgical imports and exports during the past three years are here given, the amount being in metric tons:—

IMPORTS.	1879.	1878.	1877.
Steel—			
Cast	230	551	942
Bar, plate, wire ..	3,680	3,750	3,432
Wrought	596	681	541
Pig and scrap ..	194,291	207,217	184,212
Rolled iron—			
Wire	2,344	3,671	4,153
Rails	891	51	448
Plates	182	149	333
Unclassed.. ..	5,260	4,539	4,571
Wrought iron—			
Anchors and chains	191	144	129
Nails	393	400	415
Unclassed ..	2,816	2,888	2,559
Castings	1,367	2,032	1,458
EXPORTS.			
Steel—			
Cast	415	93	15
Bars, plate, wire..	43,411	33,010	16,045
Wrought	3,132	3,954	2,177
Pig and scrap ..	36,465	5,412	11,816
Rolled iron—			
Wire	3,393	2,898	2,036
Rails	29,596	34,273	42,599
Plates	23,302	23,198	16,623
Unclassed ..	154,495	132,769	113,151
Wrought iron—			
Anchors and chains	8	—	—
Nails	8,308	9,096	10,296
Unclassed.. ..	20,327	17,610	13,543
Castings	12,862	10,551	1,999

At the beginning of 1879 forge pig was barely worth £2 a ton in Belgium, and foundry £2 12s. 6d. In June these prices remained unchanged, the standard price of bars varying between 115 and 120 fr. (£4 11s. 3d and £4 15s. 2d.) In the first half of 1879 the Cockerill Company tendered for Bessemer rails to the directors of the Alta Italia Railway at a rate corresponding to 113 fr. (£4 9s. 3d.) at the works. On September 3rd the same company offered goods of the same class to the Belgian State Railways at 129 fr. 60 (£5 2s. 10d.) This price being found too high the specifications were later on placed again in the market, when the lowest offer was 139 fr. (£5 10s. 4d.) The specifications were again withdrawn, but the market showing unmistakeable symptoms of improvement, the Government invited tenders a third time on December 17. The lowest price now offered was 189 fr. (£7 10s.), and the Government was now content to accept for fear of a worse thing happening. At this same adjudication the lowest quotation for iron rails was 170 fr. (£6 14s. 10d.), and the highest 184 fr. 30 (£7 6s. 4d.) At the end of December best plates were quoted at 320 fr. (£12 15s.) at Liége.

The following table shows the duties levied in Belgium on imported siderurgical products:—

	Per ton. fr.		£	s.	d.
Pig-iron	5·00	..	0	4	0
Castings	20·00	..	0	15	10
Rolled irons	10·00	..	0	8	0
Forgings	40·00	..	1	11	9
Ingot steel	5·00	..	0	4	0
Steel in bars, plates, wire	10·00	..	0	8	0
Wrought-steel	40·00	..	1	11	9
Tin plate	30·00	..	1	3	9
Tin-plate goods, 10 per cent. of value.					

The right of importing raw material duty free for a restricted period *(franchise temporaire)*, when such raw material is to be worked up into finished goods destined for export only profits the foundries and houses making and exporting steel rails.

Theoretical studies of metallurgy occupy a high place in Belgium. The special training schools of Liége, Ghent, Brussels, Mons and Louvain yield a yearly supply of trained technical intelligence of a high order for the service of manufacturing industry. The old scholars of these institutions form among themselves voluntary associations, in the meetings of which all new facts and scientific theories are submitted to a searching investigation. A chair of industrial geography was founded at the Liége School of Mines in 1880.

The year we are now reporting on has seen the grave close over an eminent metallurgist, M. Désiré Blondiaux, forgemaster at Thy-le-Château. He had brought his works into the front rank of metallurgical establishments, and had lately drawn the attention of specialists to them in connection with the experimentation carried out in them on Ponsard's furnace. M. Blondiaux died July 6th, 1879.

FRANCE.

By FRANCIS LAUR, St.-Etienne.

THE iron trade of France is scattered over 61 out of its 88 continental departments. It comprises 428 distinct works, served by 1490 steam-engines and 829 hydraulic motors, having between them a total power of 109,000 horses. The hands employed in these works number 120,000; with those dependent on them a total is reached of 900,000 souls whose fortunes are affected by the iron trade. Among the departments which receive the benefit of the industrial activity due to the manufacture of iron there are 43 the geological conditions of which enable them to become producers of ironstone. This is won in 410 workings, the annual output from which is roundly 3,500,000 metric tons. The total weight of pig made averages 1,400,000 tons. Iron is made in 52 departments to an annual average weight of 650,000 tons; plates, to 105,000 tons; and steel, 281,000 tons. The average value of the various products of French metallurgical industry per annum would be 430,000,000 fr. (£17,200,000).

The wages paid in the iron trade in France are generally high. Puddlers, reheaters, and mill hands earn up to 200 fr. (£8) and beyond per month. They have found for them, gratis, house-accommodation, coal, a plot of ground for vegetables, and other gratis privileges, so that their real position is that of men earning 300 fr. (£12) per month, or 10 fr. (8s.) per day. Second class men get 150 fr. (£6) per month, and the lowest class of hands and labourers 3 fr. to 4 fr. (2s. 4d. to 3s. 2d.) a day. But for all and every one, there are found, gratis, lodging, warming, and a share of a kitchen garden; the rule being so general that in the few cases where these advantages are not granted to the hands they have a proportionate allowance made in respect of them.

It may be of interest to glance at the progress made by the iron trade in France during the past twenty years. The following table shows the weight of pig, irons, plates and steels manufactured in France from 1859 to 1878:—

Year.	Pig.	Irons.	Plates.	Steel.
	tons.	tons.	tons.	tons.
1859	758,682	466,823	64,946	16,922
1860	797,932	443,758	59,471	21,244
1861	829,481	518,101	73,671	26,169
1862	928,574	580,549	67,846	30,490
1863	933,907	641,465	66,320	25,372
1864	1,034,161	657,073	93,808	28,189
1865	989,972	581,504	95,271	31,816
1866	992,710	659,871	99,243	28,286
1867	931,906	613,859	90,301	36,855
1868	934,868	622,599	95,673	66,320
1869	1,018,899	699,249	101,952	91,284
1870	923,842	539,269	78,565	83,788
1871	859,641	555,176	80,700	79,811
1872	127,838	754,381	129,822	130,088
1873	1,366,715	760,268	129,623	155,568
1874	1,423,307	752,050	110,204	217,072
1875	1,416,397	786,927	118,063	239,205
1876	1,395,656	759,301	114,410	230,828
1877	1,348,637	645,865	110,095	249,560
1878	1,417,073	648,647	105,688	281,800

As is shown by the above table the iron trade of France has been making steady progress, so as almost to have doubled in the last twenty years.

These generalities disposed of, we will endeavour to give a sketch of the principal features of the iron trade as they presented themselves in 1879, grouping them as follows:—Make, commercial review, technical progress, miscellaneous.

Statistics of Make.—The Government has favoured us this year, earlier than usual, with the statistics of make pertaining to each department of France in which the iron trade is carried on. The following table contains in combination the two half-yearly accounts published by the Ministry; weights, as usual, being in metric tons.

The table on the following page shows that the total make of metal in France last year was 123,495 tons below the make of 1878. This decline is referable exclusively to the falling off in the manufacture of pig-iron, which shows a deficit as compared with 1878 of 133,035 tons. Naturally, the additional pig required by forge-masters and steel makers had to be imported. The make of iron shows a falling off, but it is an unimportant one of only 5209 tons; steels show an increase of 14,749 tons.

Commercial Review.—Regarded commercially the iron trade gave rise, during the past year, to a succession of phenomena which it is worth while to pass under review. In January all metallurgical products had arrived at their lowest expression in price; the last limit of concession on cost had been reached. In April there are heard here and there whisperings of a slight advance in the value of merchant-irons. Then a month elapses without sign, unless we note that importation-warrants are beginning to get scarce. In June it becomes plain to every one that the market is improving; merchant-irons and plates are fairly in demand. In the course of the same month, several private makers receive Government orders for armour-plates, casemates, steel-plates, &c. At the beginning of the year there was as much artillery being made as anything else. The impetus to trade given by the Government was a principal cause of the market acquiring a firmness to which it had been a stranger for some years. And yet the iron trade of France is still in doubt in June as to its success. The railways hang back, and only send out the barest possible specifications; and a forward movement all along the line has to await the "railway" signal. Still, at the end of June, a rise of 10 fr. (8s.) per ton is assured for irons, which during the half-year stand at 190 fr. (£7 10s. 9d.)

It seems astonishing that at this moment forgemasters should have been incredulous as to the reality of the revival, and should have taken no measures for their own protection. Many forgemasters were found willing to book themselves forward at prices which subsequent events show to have been utterly ridiculous. However, at the beginning of August the situation of the trade was put in a very strong light by the failure of the State railways to obtain any satisfactory reply to the specifications for

Departments.	Forge pig.	Foundry pig.	Total pig.	Rails.	Merchant and profile irons.	Plates.	Total irons.	Bessemer, Martin, &c., steel.	Puddled steel.	Cemented steel.	Crucible steel.	Total steels.
	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.
Allier	67,298	11,364	78,662	3,475	19,218	9,469	32,162	21,654	130	—	—	21,784
Ardèche	43,980	12,175	56,155	—	—	—	—	—	—	—	—	—
Ardennes	15,080	86	15,166	—	40,115	21,338	61,453	—	—	55	25	80
Ariége..	13,455	—	13,455	—	8,785	—	8,785	—	2,130	—	—	2,130
Aveyron	24,508	3,430	27,938	13,309	10,017	2,587	25,913	21,293	—	—	—	21,293
Bouches-du-Rhône ..	24,515	—	24,515	—	1,157	—	1,157	—	—	—	—	—
Charentes	240	—	240	—	130	—	130	630	18	1	—	649
Cher	1,915	15,710	17,625	—	2,780	—	2,780	—	—	—	—	—
Corse	5,394	—	5,394	—	—	—	—	—	—	—	—	—
Dordogne	790	—	790	—	1,110	—	1,110	—	—	—	—	—
Doubs	320	75	395	—	1,642	2,197	3,839	—	—	—	—	—
Gard	95,999	10,570	106,569	1,333	20,088	—	21,421	59,748	—	—	—	59,748
Gironde	1,350	1,237	2,587	—	880	—	880	—	—	—	—	—
Isère	16,332	746	17,078	879	8,906	661	10,446	2,000	3,113	288	516	5,917
Jura	6,150	—	6,150	283	9,127	9,076	18,486	—	—	—	—	—
Landes	9,212	4,463	13,675	—	2,982	—	2,982	—	—	—	—	—
Loire	56,533	—	56,533	654	43,127	16,041	59,822	83,180	6,242	2,035	5,385	97,843
Loire-Inférieure ..	354	5,188	5,542	—	7,032	—	7,032	—	—	—	—	—
Lot-et-Garonne ..	780	14,050	14,830	—	180	—	180	—	—	—	—	—
Marne	—	2,435	2,435	—	—	—	—	—	—	—	—	—
Haute-Marne.. ..	26,117	35,075	61,192	—	76,370	4,950	81,320	—	—	—	—	—
Mayenne	—	3,082	3,082	—	—	—	—	—	—	—	—	—
Meurthe-et-Moselle..	301,687	120,179	427,866	—	35,675	7,419	43,094	—	1,380	—	—	1,380
Meuse..	1,315	5,990	7,305	20	17,000	700	17,720	37	—	—	—	37
Nord	170,167	—	170,167	17,482	210,998	25,766	254,246	31,468	—	—	—	31,468
Pas-de-Calais ..	29,318	22,000	51,318	—	449	—	449	—	—	—	—	—
Pyrénées-Orientales ..	5,706	—	5,706	—	540	—	540	—	—	—	—	—
Rhône..	50,031	—	50,031	—	—	—	—	—	—	—	—	—
Haute-Saône	3,220	938	4,158	—	422	720	1,142	—	—	—	—	—
Saône-et-Loire ..	138,603	804	139,407	3,285	37,919	17,504	53,708	71,172	—	—	—	71,172
Tarn-et-Garonne ..	1,045	—	1,045	—	2,138	—	2,138	—	—	—	—	—
Aube	—	—	—	—	7,924	—	7,924	—	—	—	—	—
Côte-d'Or	—	—	—	—	13,554	340	13,894	—	—	—	—	—
Haute-Garonne ..	—	—	—	—	3,724	—	3,724	—	47	49	—	96
Nièvre	—	—	—	213	12,777	449	13,439	8,885	158	—	578	9,621
Oise	—	—	—	—	19,203	13,287	32,490	101	—	—	—	101
Seine	—	—	—	—	19,050	—	19,050	—	—	—	—	—
Tarn	—	—	—	—	898	—	898	—	608	220	376	1,204
Yonne..	—	—	—	—	10,640	—	10,640	—	—	—	—	—
Other departments ..	—	—	—	—	24,417	8,480	32,897	347	25	5	89	466
Make, 1879	1,112,414	275,825	1,388,239	40,933	655,985	140,984	837,903	302,516	14,533	3,652	6,969	327,670
" 1878	1,167,117	354,157	1,521,574	52,172	658,766	132,234	843,112	283,377	20,454	1,958	7,132	312,921
Increase	—	—	—	—	—	8,750	—	19,139	—	1,694	—	14,749
Decrease	54,503	78,332	133,035	11,239	2,720	—	5,209	—	5,921	—	163	—

Total make	1879	..	2,553,812
	1878	..	2,677,307
Decrease in 1879		..	123,495

rails issued by them. The minimum tender is in excess of the maximum of the specifications. Makers now begin to feel their strength; and the end of August sees every branch of trade active. Orders come in thick and threefold; then, after a period of harass comes one of slackness, and there were some dull days in September. Just at this moment the revival comes like a thunderclap in England, Belgium and Germany. But in France business will not be frighted from its propriety, and not till October do the forge-masters and their customers agree as to the reality of the advance. Prices go up, therefore, but yet gradually. The directors of the State railways, being more shrewd than the directors of private companies, come into the market for lots of 20,000 tons of rails at a time. But the characteristic feature of the year is yet to be developed. At about the beginning of October, American buying begins to create a vacuum in the French stock of pig-iron. Bold speculators buy at prices at which, especially at first, they clear large profits; the piles of pig heaped round our furnaces shrink with astonishing rapidity. A rush is made on ferro-manganese which advances from 350 fr. (£13 17s. 9d.) to 400 fr., 450 fr., 500 fr., and 600 fr. (£23 16s.) With the arrival of November and December the directors of private lines decide on ordering small material, and come at last into the market to find it crowded. The revival now fairly commences, three or four months later than in the rest of the Continent; although it is true that it still maintains its first vigour. Prices go up to 240 fr. (£9 10s. 6d.) for irons and 280 fr. (£11 2s.) for steels. The year closes amidst this brilliant display of commercial fireworks, the set piece of which was formed by a group of the highest prices achieved in the present period of the history of the French iron trade.

If we were asked to trace in miniature the characteristic features of this curious year we should say—1879 opened badly; the railway companies were starving trade, which was kept up almost entirely by Government orders for war material; small consumers began to prick the market into a half-awake condition. The State improves on its previous benefits by ordering armour-plates for its ships and rails for its railways. Finally, America came in like a flood on the market, and forced up the price of all classes of goods alike. "All's well that ends well," and we can only wish that the annals of the iron trade in France may number many such years as 1879.

Technical Progress.—France has, during the year, possessed one feature of progress in common with England, Belgium and Germany—I refer to dephosphorisation. This process has furnished another example of a *modus faciendi* characteristic of the national mind. It was M. Grüner, our respected Inspector-General of Mines, who was the first to lay down, in a clearly-written and well-methodised work, the theoretical data of the process of dephosphorising by means of lime in the Bessemer converter. Naturally the theory crossed the Channel; it grew into practical form in the hands of Messrs. Thomas and Gilchrist; the dephosphorisation agitation next spread to Belgium, then to Germany and Austria, giving rise on its way to the Krupp or Harjes-Bender process for the refining of phosphoretic pig on the hearth.

As a matter of course, therefore, the new process, which had its theoretic birth in France, came back to us after having made the tour of Europe and received consecration at the hands of the foreigner. It was not till May, 1879, that the interest of French engineers began to be aroused. They came to the spring meeting in London of the Iron and Steel Institute, and heard details which led them to give their sympathies to the Thomas-Gilchrist process, although they doubted of its immediate realisation on a practical scale. The intermediate operation is then proposed in France by M. Harmet, who, after a partial refining of the metal in the ordinary converter with a silicious lining, conveys it into a second converter with a basic lining, like that of Messrs. Thomas and Gilchrist. This was an intelligent effort to create a French dephosphorisation process. Experiments made with it at the Witkowitz Works, in Moravia, gave excellent results, so far as the quality of the metal was concerned, which resembled that made from the best charcoal pig. But with this intermediate operation is joined the drawback of prolonging the blow for fifteen minutes, and thus cooling the charge.* This untoward result may, in part, have been caused by the employment of imperfect apparatus; but, so far as I know, M. Harmet had not succeeded at the end of 1879 in turning his difficulty.

M. Ponsard is the only metallurgist in France who has made any progress in the method of dephosphorising on the hearth. The heat he obtained in his experiments with the forno-convertisseur was insufficient, and the charge could not be got out of the furnace entire. How the metal would roll we are not, therefore, able to say. Full analyses of samples both of metal and slag have been made in the laboratory of the Creusot Works. It has been proved that with a sufficient heat, pig containing 2 per cent. phosphorus, could have been converted into steel containing less than half a thousandth.

Theoretical discussions on the dephosphorisation question have been very animated in France. In June last, M. Pourcel, of the Terrenoire Works, opened a vigorous campaign in favour of silicon, laying down the thesis that the elimination of silicon and phosphorus during the blow was parallel. He was replied to from Germany by M. Massenez, who "made a treaty of friendship with phosphorus while declaring war on silicon." M. Massenez even added phosphorus to his raw metal.

Both champions, in the eyes of most onlookers, appear to have fallen into a certain exaggeration. The fact seems to be that it is better to have pig poor in silicon, but to add silicon at the end of the blow in order to combat against carbon and prevent rephosphorisation on the addition of the spiegel.

The campaign undertaken by M. Pourcel has, therefore, not been fruitless. The simultaneous elimination of silicon and phosphorus has not been confirmed by actual working. But, at least, the confirmation of the principle to which we owe steel without blowholes—*i. e.*, the principle of the influence of silicon on the non-development of carbonic oxide—is established. Its efficacy in the period of over-blowing may possibly be considerable.

Thus theoretical discussions are shown always to have their use. Although the study of the phosphates has yet to be undertaken, and the different states of the phosphorus are yet unknown, some points have been elucidated. The whole world knows now:—(1) The influence of the silicon on the carbon; (2) the rephosphorisation of the metal by the addition of the spiegel; (3) the incontestable elimination of the phosphorus by the basic lining. Little by little the world will become acquainted with the manifold reactions which take place during Bessemer's marvellous operation.

The share to be claimed by France in 1879 in the dephosphorisation question may be thus summarised:—Theoretic statement of dephosphorisation, by M. Grüner—Harmet's intermediate process—

---

* This has caused the Witkowitz works to return to the unmodified Thomas and Gilchrist process.—T.

M. Pourcel's theories—Experimentation with fornc-convertisseur with basic lining.*

Miscellaneous.—I will close this review of the iron trade of France by some scattered details collected here and there throughout the country concerning the special features of various metallurgical firms and the progress made by those firms.

Two new works have been founded in the course of the year—the St. Nazaire Ironworks, situated at Segré, near Rennes, in the neighbourhood of considerable ironstone deposits, and favourably situated for the reception of English coke, and the Balaruc Works, near Cette, the site of which has been determined by conditions of easy supply of Mediterranean ironstone on the side and Gard coke on the other. The St. Nazaire Works are laid out for a yearly make of 25,000 tons of miscellaneous goods—artillery, projectiles, tires, axles, profile irons and steels, machinery parts, &c.

Both these works have built blast-furnaces for themselves, the Balaruc Works will be open for business within a very brief period.

If France does not export metallurgical products in large quantities, she has done something in the way of exporting metallurgical producers—particularly to Russia. M. Verdié, from the Loire, has laid out the Huta-Bankowa Works, near Dombrowa, on the Polish frontier. M. Barrouin, also from the Loire, has organised a concern on the lands belonging to Prince Galitzin, in the Ural, under the title of the Société Métallurgique Franco-Russe. Towards the end of 1879 began to be discussed another heavy undertaking—a shipbuilding yard at St. Petersburg. The names of MM. Montgolfier and Marrel, of the Loire, have been given as the heads of this undertaking.

The end of 1879 was very favourable to the ferro-manganese trade. Prices rose at a bound in consequence of the large American demand, and the Terrenoire and the St. Louis Works began to make up their full capacity of production. The latter works, situated near Marseilles, in the department of the Bouches-du-Rhône, has enjoyed a particularly prosperous season.

The St. Chamond Works (Aciéries de la Marine), in the department of the Loire, has during the year set up a powerful hammer of 80 tons, remarkable for the power of its crane, which carries from 120 to 200 tons, for the ingenuity with which the standards and the different parts of the anvil bed are built up, and the simplicity of the apparatus for the admission of steam. These works are making every day greater progress, and have entered on a marked period of prosperous activity.

The Terrenoire Works had a large output in 1879 of solid steel—steel without blow-holes. The experiments carried out on June 23 at La Spezia, showed that armour plates made of solid cast steel resisted penetration better than other varieties, although the crushing was considerable, and the planking behind the target was broken up. This company is prompt in welcoming new inventions and in experimentation. It is a pity that the latter should be so costly.

The Creusot Works are doing well, although the reproach (if it be one) is levelled against them of delaying the adoption of new processes until bolder people have found out what they are worth. However, I am informed on good authority that experimentation with dephosphorisation on the hearth has been carried out in secret at the end of the year.

At St. Etienne several deputies of the Loire, MM. Crozet-Fourneyron and Menard-Dorian among them, have given their help towards the establishment of a factory for the manufacture of all kinds of tools, of which MM. Vogeli Bros. are the managers.

The Decazeville Works (Aveyron), the future of which is bound up with the dephosphorisation process, have been making experiments in secret with the elimination of phosphorus on the hearth in the form of phosphate of alumina, with the help of bauxite (natural hydrate of alumina).

The Denain Works (Nord) are going on improving their admirable plant, and have only to progress a little in the same direction to stand at the head of all works in the north of France. Experiments have been made at their works in dephosphorising by the intermediate process.

At the Forges de Châtillon et Commentry the company made during 1879 about as much as in previous years in the old works. The normal make was about 70,000 tons, but to this has to be added for 1879 from 20,000 to 25,000 tons made at the Beaucaire establishment, which has been for some months doing a normal amount of work. The total make for 1879 was thus between 90,000 and 95,000 tons. Apart from steel rails, both at Montluçon and Beaucaire, other branches of manufacture have fluctuated considerably, plates, points and wire being especially capricious. The demand for beams was tolerably steady after the spring of 1879, owing to the extension of building operations at Paris. In 1879 a new branch of manufacture was begun in the shape of turrets in chilled metal for fortifications. Three turrets out of 26 ordered have been finished to the satisfaction of the military engineers. The first, which is at the same time the first of its kind in France, has already been mounted.

Engineering works were only moderately employed during 1879.

MM. Ernest Gouin and Co., of Paris, who are locomotive builders and railway engineers, had a season similar to that of 1878. The low prices at which locomotives were made cut off all profit.

At the Ria Ironwork (Pyrénées orientales), belonging to Holtzer, Dorian and Co., the season presented very few features of interest. Only one furnace was in blast in 1879 out of three, but the make rose from 10 to 15 tons by improving the blast. Charcoal pig was made at Ria, the make being about 900 tons per month, 500 or 600 tons of it going to the Unieux Forge (Loire). The manufacture of charcoal pig in this district languished through the increasing dearness of fuel, which has to be brought from Italy, Spain, &c.

In spite of its exceptionally high qualities, due to the use of roasted and washed carbonates as ore, the making of native pig is unprofitable, and it only sells in small parcels.

The Société des Hauts-fourneaux et fonderies de Couches et Breteuil (Eure) was occupied only on castings in 1879, working up No. 3 and No. 4 English pig, and No. 7 Lorraine pig, two-thirds of the former to one of the latter, buying a certain quantity of No. 1 Scotch pig for machine castings. For parts of the agricultural machinery used by silk growers, white hematite (Harrington) pig was used. The total weight of castings was only 3050 tons, or 1200 tons below 1876. Of hollow ware 200 tons were made.

The foundries of Normandy were not badly off, but the consumption of castings was limited.

The finer classes of heavy work—forgings, tools, anvils, springs—at the works of Claudinon and Co., Chambon (Loire), have not varied much from 1878; prices have been unremunerative.

We will give a concluding detailed example of the course of business during 1879 in a large French steelmaking concern in turning to the Aciéries et Forges de Firminy (Loire).

The blast-furnaces continued to give the same good results as in preceding years—steady working, large output, small consumption of fuel. Supplied with excellent ore from Mokta-el-Hadid under a long-term-contract, and with rich and pure ores from the Mediterranean coast, this furnace yields fine pig for steel making, spiegel, and ferro-manganese, with combinations of which steels and irons are made of a high-class. The steel foundry where the Siemens Martin process was introduced twelve years ago, is continually improving the quality of its products, and lowering their price. A new material, "run metal" *(fer fondu—flusseisen* in German)* has begun to be employed and to be appreciated. The manufacture of crucible and cemented steel underwent extension. Steel guns were made as in previous years. For the forging of siege guns a 20-ton hammer has been built, which began its work early in 1879. Steel forgings have increased, and a new 10-ton hammer has been added to the plant employed on rails, axles and tires. Railway and common carriage springs were made to about the usual weight. Cutting tools of all kinds were made in greater than usual numbers, and the progress made in agricultural machinery has led to the opening of a department for making agricultural implements in steel. In agricultural, as in other machinery, steel is gradually driving out iron, wrought and cast. In the same way steel is replacing iron as the raw material for wire, and an elaborate wire mill has been erected at Firminy to enable the company to meet the competition of England and Germany. The first parcels of steel wire made at Firminy were put on the market in the early part of 1880.

Perhaps sufficient examples have been given to show that 1879, considered from a commercial, a technical or a manufacturing point of view, was an average year, good rather than bad. Its greatest merit was to introduce 1880, which I hope will be distinguished as one of the good years of the iron trade in the period from 1872 to 1882.

SWEDEN.

By Professor RICHARD ÅKERMAN, Stockholm.

THE total area of Sweden is 170,629 square miles, 11,300 square miles of which are covered by water. The number of inhabitants on this large surface at the end of 1878 was only 4,531,863, but of these more than 90 per cent lived in the southern half of the country. The same half possesses also nearly all the railroads which as yet have been opened for traffic. Altogether there were open at the end of 1879, 3577 miles (5769 kilometres) of permanent way, 1200 miles (1936 kilometres) of which belonged to the Crown. Per 10,000 inhabitants, Sweden thus has 8⅛ miles (13·1 kilometres) railway opened for traffic, which, as far as I know, is the highest proportion of any country except the United States of America; but compared with the surface of the country, we only get 1·3 kilometre railway per 100 square kilometres of surface.

The population is chiefly agricultural. In 1878 only 25,400 hands were occupied in mines and metallurgical works. Of these 4397 worked in the iron mines, and 16,716 at iron and steel works.

Sweden is rich in magnetic and specular ores, and the majority of them are very free from phosphorus. The far-north part of the country contains some heavy deposits of very rich magnetic and specular ores at Gellivare, Luosavara, Svappavara and Körunavara, but a great deal of these ores are rather rich in phosphorus, and as they are situated in a mere wilderness far from the coast, they have not yet been developed. The other deposits are situated in the southern half of Sweden and chiefly in a zone west and north-west from Stockholm.

All the magnetic and specular ores belong to the primitive or Laurentian formation, and occur, with very few exceptions, as beds in metamorphic rocks, such as gneiss, eurite, felsite, schist, mica-schist and hornblende-schist, or crystalline limestone.

The most important of the iron mines are:—

I. *Norberg*, where the ores are chiefly specular and are rather silicious, but also magnetic ores rich in limestone are won in other mines there. In 1878, 129,614 metric tons of ores were raised at Norberg.

II. *Nora* district, where both specular and magnetic ores of somewhat different qualities are got. In 1878, 88,469 metric tons were raised in that district.

III. *Dannemora*, with only magnetic and rather basic ores, which are exceedingly pure, so far as phosphorus is concerned. The production of 1878 was 45,600 metric tons.

IV. *Persberg*, where the ores are also magnetic, and very free from phosphorus. In 1878, 38,253 metric tons of ores were raised there.

V. *Grängesberg*, the deposits of partly magnetic and partly specular ores of which are very important. The ores, too, are very rich in iron; but as they often contain a great deal of phosphorus these deposits have not been nearly so well developed as they easily could be.

As characteristic of the Swedish iron ores may be mentioned their richness in magnesia and poorness in alumina. The following analyses give an idea of the composition of the ores got from the said districts:—

	Fe_2O_3.	Fe_3O_4.	FeO.	MnO.	MgO.	CaO.	Al_2O_3.	SiO_2.	P_2O_5.	S.	Loss by ignition.	Total.	Fe.
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
NORBERG, Risberg	51·31	19·89	—	0·05	1·46	3·24	1·16	22·46	0·069	0·008	0·20	99·847	50·32
„ Morberg	48·86	19·05	—	trace	1·20	2·60	1·20	26·20	0·056	0·004	—	99·170	48·00
„ Kallmora	—	80·65	0·14	0·25	4·51	1·80	1·70	10·50	0·021	0·014	—	99·585	58·50
„ Klackberg ..	—	56·97	5·62	6·70	5·50	5·46	0·14	2·54	0·004	trace	16·30	99·234	45·62
NORA, Striberg	62·14	10·36	—	0·04	0·34	0·52	1·19	25·50	0·045	0·022	—	100·157	51·00
„ Dalkarlsberg	51·04	28·95	—	trace	4·45	2·61	0·60	12·29	0·137	trace	—	100·077	56·72
„ Pershyttan	74·61	—	—	0·15	0·58	0·45	3·14	20·20	0·057	trace	—	99·187	52·20
„ Viker	—	57·34	—	3·66	9·20	2·34	2·16	10·83	0.050	0·24	13·20	99·02	41·50
DANNEMORA, north part ..	—	65·86	1·43	0·89	4·34	7·62	1·08	15·32	0·002	0·171	2·80	99·513	48·80
„ middle part ..	—	71·65	0·71	2·23	5·66	5·20	1·49	9·30	0·005	0·027	3·00	99·272	52·44
„ south part ..	—	72·25	1·50	2·05	4·14	5·50	2·60	8·90	0·007	0·038	1·80	98·785	53·49
PERSBERG, Krangrufvan ..	—	71·56	5·11	0·17	4·18	4·85	0·77	12·76	0·005	0·031	—	99·436	55·79
„ Skärstöten ..	—	72·17	2·20	0·27	8·53	3·42	0·35	10·51	0.024	0·029	1·92	99·423	53·97
„ Storgrufvan ..	—	76·08	3·60	0·09	3·13	5·12	0·95	11·35	0·005	0·025	—	100·350	57·89
GRÄNGESBERG, Per Daniel	62·44	23·20	—	0·16	0·51	1·08	0·33	12·44	0·412	0·017	—	100·589	59·51
„ Gatthufvud ..	25·72	58·36	—	0·37	1·26	1·29	0·28	12·23	0·231	0·023	—	99·764	60·27
„ Ormberg ..	39·30	41·56	—	trace	0·72	1·40	2·84	13·30	0·325	0·040	—	99·485	57·60
„ Lomberg ..	78·20	—	—	0·33	0·43	0·84	2·20	18·30	0·183	0·040	—	100·523	54·70

The winning of the ore is in general carried on by sinking shafts, driving levels and underhand stoping, but in late years the method of replacement and overhand stoping also have grown more and more common.

---

* We may add that in December, 1879, excellent results with the original process were obtained at Creusot by Schneider and Co., who were the first licensees on the Continent of Europe under the Thomas Patents.—TR.

* *Flusseisen* is commonly englished by ingot iron, which is generally metal made in the converter. An English term for *fer fondu* is wanting.

The total amount of magnetic and specular ores raised in 1878 was 672,434 metric tons. Except magnetic and specular ores Sweden has no other iron ores than lake and bog ores; but of these only 4913 metric tons were raised during the same year. The largest production of iron ores which has ever been got in Sweden was in 1874, when 922,524 metric tons magnetic and specular ores and 4300 metric tons of lake and bog ores were raised.

The reason why the production of iron ores in Sweden is not greater is that the country has no coal, except in the extreme south, at a distance of about 500 kilometres (310 miles) from the iron mines. The manufacture of iron is thus restricted to the use of charcoal, and as the forests in the neighbourhood of some of the mines are becoming bare, charcoal is now carried very long distances.

In 1878, Sweden had 346 blast-furnaces, of which 193 were on blast. Charcoal only is used in all blast-furnaces except two, which make spiegeleisen with a mixture of charcoal and coke. The greater number of the blast-furnaces do not run the whole year through, but only for some months. The average time of running for all the blast-furnaces of Sweden in 1878 was only 186 days. The height of the furnaces varies from 30 to 55 feet, and the diameter at the boshes from 7 to 10·5 feet. The charges yield in general 40 to 52 per cent. of pig-iron, and the consumption of charcoal varies from 70 to 120 units per 100 units of pig-iron produced. The production of pig-iron per day and furnace varies from 6 to 17 tons.

Depending on the ores used and the management of the furnaces, the average composition of Swedish pig-iron varies thus:—

	Per cent.		Per cent.
Carbon	3·5	to	4·5
Silicon	0·1	,,	1·0
Sulphur	0·0	,,	0·04
Phosphorus	0·001	,,	0·15

As characteristic for the Swedish pig-iron manufacture there deserves to be mentioned the strong calcining of the ores in the Westman gas-furnace, and that the calcined ores, before being charged into the blast-furnace, are crushed between rolls, or Blake's crushers, to the size of a walnut or under.

The production of pig-iron in 1878 was 340,806 metric tons. The highest amount ever made was in 1876, when 352,622 metric tons were produced.

By far the greatest part of Swedish pig-iron is refined in charcoal hearths, of which the variety called the Lancashire hearth is the most common, and the wrought iron thus got is reheated in gas-furnaces (Ekman's and Siemens-Lundin's) and hammered or rolled out to bar iron, rods or wire. In the Ekman reheating furnaces charcoal was chiefly used in former times, but of late English coal is becoming more and more used. In the Siemens-Lundin furnaces, peat, wood and sawdust are used as fuel. Rolling has become more and more common, so that probably more iron now is rolled than hammered in Sweden.

The production of bar iron, rods and rolled wire in 1878 was 197,931 metric tons. The largest production was in 1877, when 224,785 metric tons were made.

Puddling has been carried out at only very few Swedish works on account of the deficiency of coal, and when used it has commonly been for the manufacture of plates. But as Bessemer iron is now very often preferred to puddled iron for plates, a large proportion of the few puddling furnaces erected in Sweden, have been idle in late years, and very little iron has been puddled.

Not less than 23 Bessemer works have been erected in Sweden, but very many of these can scarcely be said ever to have been running on a practical scale. In 1878 only 5 Bessemer works were running during the whole or the greater part of the year, but 6 other Bessemer works were running shorter times, and the same can be said about last year.

From the very first time the Bessemer process was started the pig-iron has in Sweden always been tapped directly from the blast-furnace into the converter, and as the hearths of the charcoal blast-furnaces cannot hold more than 3 tons of pig-iron, the Bessemer blows are most commonly made with that quantity. As, farther, the pig-iron production of the charcoal blast-furnaces is very slow, only 4 blows are performed per day, when only one blast-furnace is running, and thus the production of a Swedish Bessemer works is very small.

The fixed, or so-called Swedish converters, are not in use any more, but only tilting converters, and the blows are commonly finished in six to fifteen minutes.

The Bessemer production in 1878 was 19,303 metric tons. The largest production of Bessemer metal ever got was in 1874, when 21,312 metric tons were produced.

Of Siemens-Martin metal the production in 1878 was 3608 metric tons, which is the largest ever got. It was nearly all made at a single establishment.

Of other kinds of steel the production in 1878 was 3003 metric tons.

The production of iron and steel in Sweden in 1879 is not yet known, but most probably it was considerably less than in 1878, although the export of 1879 was larger than in either the previous or any other year.

The exports were:—

	1878. metric tons.		1879. metric tons.
Iron ores	13,534		12,800
Pig-iron	27,989		36,150
Blooms	9,713		10,740
Bar iron	113,357	149,429	169,400
Hoop iron, rods and rolled wire	34,157		
Plates	925		
Nails	990		
Steel and ingot iron ..	5,155		8,450
Scrap	9,344		?

The imports during 1879 are not yet known, but in 1878 they were:—

	metric tons.
Pig-iron	13,295
Rails	21,597
Bar iron	1,586
Hoop iron, rods, &c.	1,984
Plates	2,170
Tinned plates	946
Nails	654
Steel and ingot iron	276
Scrap	239

As is well known, the years 1878 and 1879 were perhaps the most disastrous ever known for the iron manufacture of all Europe. The same was the case in Sweden, and the increased export during 1879 does not at all give a proof of the contrary, but only of a diminished consumption in Sweden itself. If an iron as good and sound as the Swedish can be got nearly as cheap as common iron, of course it always will get a market, and that is the reason of the large export during last year.

The average price of Swedish bar iron at Stockholm in 1879 was only kronor 5.75 per centner (£6 6s. 6d. per ton); but the average price in 1869, before the great rise culminating in 1873, when the average price was kronor 13·16 (£14 10s. per ton) was kronor 6·50 per centner (£7 2s. 6d. per ton.)

At the end of September last, the American demand for iron also began to have its effect in Sweden, and in consequence thereof prices began to rise. The rise was at first slow; but, at the end of 1879, and still more at the beginning of the present year, prices rose very fast, so that the price of bar-iron at Stockholm as early as February was kronor 9·00 per centner (£9 18s. per ton). Pig-iron, which during last year had been sold at the works as low as kronor 2·00, rose to kronor 4 and 4·50 (£4 8s. and £4 19s.); but since February prices have not risen further.

The great change in prices of course has had a strong effect on the production of iron; and, if not hindered by a deficiency of snow and rain (on which Swedish ironworks, as carried on by water-power, are very dependent), the production of the present year will most probably be the largest ever known.

How much the iron manufacture of Sweden is limited by the want of charcoal more than by anything else has most clearly been shown during last year and this. In 1879, the prices of charcoal were lower than they had been for at least thirty years, but at the beginning of this year they rose at such a rate that, in places where charcoal could be got last year at kr. 3·40 (3s. 10d.) per barrel (1 Sw. barrel = 5·82 Engl. cubic feet), it cost at the end of February last kr. 10·00 (11s.) per barrel. Of course, the value of iron ores, &c., also has risen, but not at all in the same proportion.

As is shown, the iron imports of Sweden chiefly consist in rails and pig-iron, which latter only is used for ordinary castings.

Iron and steel are duty-free in Sweden.

Technical, like all other education, is free in Sweden, the pupils paying nothing at all, or nearly nothing. Besides ten elementary technical schools in different towns, there are five technical schools on a higher level in Stockholm, Norrköping, Malmö, Örebro and Borås; one on a still higher level at Gothenburg; and then the Technical High School at Stockholm, which is the principal one, and with which the School of Mines is united. Besides this superior School of Mines, there are two more elementary ones at Filipstad and Falun. The course at the School of Mines at Stockholm lasts three to four years; but the courses of the elementary schools at Filipstad and Falun only one year. The entrance examination at the Stockholm School of Mines is naturally much more difficult than in the case of the two others mentioned.

April 8th.

SPAIN.

By José Alcover, Madrid.

My report on the iron and steel industries of Spain, is necessarily based on private information, no official statistics with reference to those trades having been published later than 1875.

The number of known mines of ironstone in Spain is so considerable, that there is no practical interest in enumerating them or in calculating their total probable yield. Taking into account first-class ores only, we may safely aver that Spain possesses thousands of millions of tons of ironstone. For this reason it is not essential to our purpose to consider more than those deposits which on account of their relative situation or other adventitious circumstances have been already opened up for working or are likely to be opened up in the proximate future. The winning of ironstone in Spain on a large scale is conducted solely with a view to exportation, the qualities of Spanish ore being well known and widely appreciated.

The make of iron in Spain is very small, both in absolute weight and relatively to internal consumption. Taking iron and steel together the following figures will give the annual calculated consumption for the next twenty years:—

	metric tons.
For keeping in repair 10,000 kilometres (6220 miles) of permanent way ..	50,000
For railway extensions and tramways ..	100,000
Waggons and trucks, construction of new and repair of old	50,000
Bridge work and public works generally ..	20,000
Mercantile marine	10,000
Navy	15,000
Merchant irons	40,000
	285,000

To this total may be added from 30,000 to 40,000 tons of cast iron consumed in the precipitation of copper.

To meet this consumption there was made in Spain in 1879:—

	metric tons.
Pig-iron	48,000
Malleable (refined from pig)	30,000
,, (direct process)	3600
Steel of all classes	350
Scrap	13,000

To give the total of these items would be to reckon the greater part of the 48,000 tons of pig twice over. Most of this amount goes to be worked up into the 30,000 tons of wrought iron above given; a small part leaves Bilbao for foreign ports, and a little is worked up for castings. Such metal as is made in Spain is the product of the blast-furnace and the puddling furnace. As yet, Spain possesses no Bessemer apparatus or Siemens-Martin furnace. A few Catalan hearths are still in existence, and a very few Fouranjin furnaces[*] for making iron by direct process; but they have no importance whatever.

The iron trade, properly so called, and carried out on any considerable scale, is represented by that which exists in two districts only—one, the province of Oviedo; the other, the province of Biscay. In these provinces only are found coke blast-furnaces. These, however small, defective and antiquated they may be for the most part, there is yet a tendency to improve. In these two districts were made in 1879, 35,700 of the total 48,000 tons above given—the remaining 12,300 tons having been, for the most part, smelted with charcoal in small ironworks situated in the provinces of Biscay, Malaga and Seville, leaving a certain small amount to the credit of a few other small and scattered works of no present or prospective importance. A considerable percentage of these charcoal irons is taken into use for common purposes; but, as coke irons grow more plentiful and cheap, makers of charcoal irons in Spain will at last, as they have done elsewhere, confine their operations to the making of special qualities of metal to sell as a raw material for the manufacture of crucible steel.

At the end of 1879 one of the charcoal blast-furnaces at Bilbao sent several parcels of its make to Sheffield. Irons of the same class, such as can be made at the Pedroso Works, are also, although dearer, exceedingly well adapted for making steel by the crucible process. The same may be said of Malaga irons. A little modified, they would be able to take quite a first place in this branch of manufacture. There is not much probability of the make of charcoal irons being increased in Spain; but there are localities, such as that of El Pedroso above-mentioned, where it seems as if the manufacture could be continued for an indefinite period on its present scale, the company being a large holder of well-wooded lands.

At Bilbao, a ton of grey charcoal pig takes 900 kilos. of fuel, and 4600 kilos. of ironstone, to make it, and costs the maker 75s. per ton f.o.b. At Malaga, the same quality of pig requires 1·240 kilos of fuel and 4300 kilos. of ironstone. Its first cost may be reckoned at 86s.

At El Pedroso, the same pig requires for its manufacture 1·400 kilos. of fuel, and 4200 kilos. of ironstone, its first cost going up to 100s.

The manufacture of coke-pig is mainly carried out at these works—those, namely, of Sres. Ybarra, at Bilbao, those of Sres. Duro, in La Felguera, and those of Sr. Guilhou, in Mieres. Each one of these localities has its special advantages and disadvantages, which balance each other so nearly that the value of the make is approximatively the same in each. Bilbao posseses ironstone of a high class, but is subject to the drawback of being compelled to send for its fuel to the province of Oviedo or to England. The one at La Felguera is so far from meeting all requirements that ironstone has to be brought from Bilbao and mixed with it in comparatively large proportions to make up a satisfactory charge; on the other hand, coke can be got at La Felguera at very moderate rates. At Mieres the ore is very difficult to treat—it needs the addition of an extraordinary amount of flux to run out a large excess of silica.

---

[*] The Fouranjin is a modification of the Chenot furnace.

The Biscayan blast furnaces consume 850 kilos. of coke and 4800 kilos. of ore per ton of white pig, the first cost at present prices amounting to 60s. per ton. At Mieres the consumption both of ironstone and fuel is larger, although the extra consumption is in part compensated by the lower price of the coke. Prime cost does not often exceed 54s. At La Felguera the cost to makers is about the same.

The rolling trains in the mills of Spain are mostly employed on merchant irons. There are rail trains at the works of Sres. Duro (La Felguera), at the scrap works of Sres. Girona (Barcelona), at the works of Sres. Ybarra (Bilbao) and the Mieres Works. They are not, however, on a very large scale, and are chiefly engaged on tramway rails, the importation of which is checked by a duty, while rails for railways are imported duty free. The Mieres Works are the owners of a train for rolling boiler plate, and have turned out goods which might fairly claim the brand BBB. The scrap-iron works of Sres. Portilla, at Seville, also make boiler plates.

The total number of blast-furnaces now existing in Spain is 45. Of these there were 16 on blast during 1879—8 charcoal, 8 coke. Three of these coke furnaces produced together 21,000 tons; the other five, it is evident, were so antiquated in structure as only to be able to make a total of 15,000 tons between them. Blast-furnaces on a scale to make 20,000 tons of pig-iron each a year, fitted with all necessary appliances, and brought up to the latest phase of metallurgical improvements are as yet wanting. The appearance of any such furnace on the stage of Spanish industry would be an event of double importance, since it would certainly come accompanied by Bessemer plant, the manufacture of Bessemer plant being the only branch of trade which can be quickly extended on the basis of current consumption. It would not at all follow that the introduction of such improved furnaces would involve laying cold those now on blast. The latter would probably continue to find sufficient occupation in the manufacture of current brands of forge pig. Of the 29 furnaces that lay cold during 1879 there are five or six which are capable of being blown in for smelting with charcoal, and three for coke. The remainder are so small, so defective, and so badly situated, that they may be considered as given up for good and all.

The import dues levied on iron coming into Spain are as follows:—

	England and countries with no treaty. s. d.	Countries having a treaty. s. d.
Pig-iron and scrap	20 0	18 6
Cast piping	37 6	33 0
Steel rails	65 0	61 0
Boiler plate	72 9	65 0
Bars	104 0	84 0
Wire	65 0	57 0
Wrought-iron tubes	104 0	96 0

Duty is remitted on rails imported for the arming of trunk lines.

To the action of these differential duties has to be attributed the large amount of iron and steel sold to Spain by Germany and Belgium, part of which would no doubt have been sold by England instead, but for the high duty levied in that country on Spanish wines.

Reasons for a proximate and probable increase in the make of iron and steel in Spain may be deduced as follows:—In the first place large ironworks will be opened some time during the course of the present year at Bilbao. These works were sold in an unfinished state by an English company to the Marques de Mudela: their two furnaces are capable of a larger output than the total make of the eight coke furnaces that were on blast in Spain during 1879. In the second place the probability is growing stronger every day of the erection of large ironworks in the province of Cordova, to provide for the large possible consumption that exists in the South of Spain for rails, carriages, &c. Although there is little visible evidence of the realisation of this scheme, it is clear that it will finally be carried out. In the same way, if the coalfield of Puertollano is as rich as is believed, it will become the centre of an ironmaking district which will supply the bulk of the needs of the most central zone of Spain. In Huelva, in the last place, are about to be set up blast-furnaces for smelting the ironstone which is found in connection with pyrites, and getting thus the cheapest material for the precipitation of copper.

There is every probability that efforts will be made to carry out in 1880 all the undertakings hinted at. For this present report to IRON it seemed to me desirable to show, first, the limited nature of the iron trade of Spain, and in the next place the probabilities of its extension, rather than to compile any heavy statistics concerning it as it is. The point most notable in its present state is the fact that in spite of the great existing need of rails there is in Spain, the country does not possess a single establishment for the manufacture of Siemens-Martin steel, and still exports its old rails.

Madrid, March 20.

REMARKS ON CHERNOFF'S PAPERS ON STEEL.

By Mr. WILLIAM ANDERSON, of Erith.[*]

THE Russian language is so little understood in other countries, that it is almost by accident that the labours of the many very able scientific men of Russia come to be known in Western Europe. Chernoff's investigations are an example of such obscurity, alike discouraging to their author and a loss to the scientific world. In order that a true value may be set on Chernoff's labours, it is necessary to explain that he has been for some years assistant manager of the Abouchoff Steel Works near St. Petersburg; and that before he was raised to his present position, he was more particularly connected with the forge, the Bessemer process, and other operations of the great establishment he now so ably assists in directing. It is important to note that the Abouchoff Works stand supreme in the world as regards the variety of the processes there carried on. Under the able and energetic management of the Director, Captain Kolokoltzoff of the Imperial Navy, the Abouchoff Works have developed from comparatively small beginnings to their present magnitude; from an establishment in which puddled steel was melted in crucibles and cast into relatively small masses, to great works, making use of every modern method of steel manufacture. In addition to the old casting house with nearly 2000 crucibles, the Siemens crucible furnace, the Bessemer converter, and lastly the Siemens-Martin open-hearth furnace and the Whitworth fluid-compressed steel processes, are all to be seen in operation. The forge has a dead-weight 50-ton steam-hammer, a 15-ton hammer, and a whole array of smaller hammers. There is a tire mill, and there are extensive workshops for the manufacture of ordnance of every calibre and of their projectiles, for the production of the heaviest masses in steel, whether for commercial or war purposes, for the making of gun-carriages, for crucible manufacture, &c. Lastly, in order that the work may be carried on in a scientific manner and on assured principles, the establishment is provided with an admirable laboratory, with one of Kirkcaldy's testing machines, and with every appliance necessary for investigating the nature and properties of the metal which forms the staple product of the place.

With the opportunities which the Abouchoff Works present, and with the aid and encouragement of Captain Kolokoltzoff, seconded by his own remarkable talents and indefatigable industry, it is not surprising that Chernoff should have produced a series of papers, addressed to the Imperial Russian Technical Society, which have thrown a strong light upon the theoretical as well as upon the practical aspects of the steel question. Chernoff has another important claim to consideration, which is that he is perfectly unhampered by trade jealousies and trade secrets. So far from being able in any way to derive benefit from keeping his own counsel, his reputation in his profession will be increased by making his work as public as possible, and by drawing aside the veil that some manufacturers have studiously wrapped about their processes. Again, the manufacture of guns, especially breech-loading guns of heavy calibre, presents exceptional advantages for ascertaining the internal structure of the steel produced. The bore of the gun is cut out of the solid by means of crown cutters, which gives the opportunity of obtaining samples of the centres of the ingots. The perforation of the slot through which the breech block works, enables samples to be obtained at every point in a radial direction; and the surface tool work exposes the outer portions of the mass to the observer. The strengthening rings and hollow projectiles, in like manner, give great facilities for observing the structure assumed by the metal under various conditions both of form and dimensions.

Chernoff's first paper of note was read in 1868, but did not come under the writer's notice till 1876. He was then so struck by its merits that he translated it, and distributed the few copies that were printed, at first among his friends, and afterwards to many strangers interested in steel manufacture, who applied for copies as soon as the paper became widely known through notices in the professional journals. In this paper Chernoff first lays down the proposition that steel is a combination of pure iron and carbon; and that all other substances must be regarded as impurities more or less pernicious, although the introduction of an extraneous substance may, in some cases, have a beneficial effect by neutralising the injurious action of some other substance. He next broaches the theory that steel changes its properties as its temperature ranges from zero to its melting point; that up to some temperature *a* steel will not harden; that it may be further raised to a higher temperature, *b*, without undergoing any molecular change; that between temperature, *b*, and the melting point an amorphous structure is assumed; and that in cooling from the melting point to temperature *b*, the metal will crystallise according to laws which are well known as governing the crystallisation of alum and similar salts. The theory is supported by very clear reasoning and by the evidence of practice on a large scale, and seems to explain perfectly all the phenomena of annealing.

In 1876 a paper was read on "Materials for the study of the Bessemer process"[†] in which the author's object is declared to be more to make the process understood and appreciated in Russia than to bring forward any facts previously unknown. He remarks that, after twenty years' successful working in Western Europe and the United States, only two sets of apparatus had been set up in Russia, and that of these two sets only one was in actual work; and attributes this backwardness to a want of knowledge of the principles and practice of the process. The paper gives a number of interesting analyses made at the Abouchoff Works and elsewhere, and institutes a comparison as to the dimensions of apparatus, quantity of air required, and other details, in different countries and for various qualities of iron.

In 1878 appeared the paper on the structure of cast-steel ingots, which the writer has translated, and which is now in the hands of the members (Proceedings 1880, p. 152). This paper dwells in the first instance on the defects met with in steel castings, and investigates their origin; next the means by which they may be obviated or corrected are discussed; and finally, the question as to whether steel castings need forging, or other modes of working, in order to give them the tenacity which should be due to the chemical composition of the steel from which they are made. Tables of experiments are cited to show that with proper annealing, in conformity with the principles laid down in 1868, cast steel is fully as tough, tenacious and ductile as the forged metal.

One result of the investigation of the Research Committee on Steel has been to draw attention to the important part which occluded gases seem likely to play in any theory on the hardening and tempering of steel. In treating of the analysis of the gases escaping from the Bessemer converter, as given by Snelus and Tamm, Chernoff remarks on the total absence of hydrogen during the first three to five minutes of the process; and explains the circumstance by supposing that the hydrogen, which arises from the decomposition of the moisture of the air blown in, is at first absorbed by the liquid iron: but that in the course of a few minutes the metal becomes saturated with the gas, and consequently allows it to escape. This is confirmed by a fact announced by Müller in a recent communication to the German Chemical Society, namely, that his analysis of the gases occluded in cast-steel ingots showed that from 68 per cent. to 90 per cent. was composed of hydrogen, the remaining gases being nitrogen and carbonic oxide, the latter in very small quantities. He estimates the pressure of the occluded gases at 8 atmospheres; and this estimate meets with singular confirmation from a process now being introduced into the United States and into this country, namely that of causing steel ingots to set under steam pressure directly applied. In a paper read by Mr. Alfred Davis before the Iron and Steel Institute (Journal 1879, p. 477) this process is described, and the pressure required is stated to range from 5 to 10 atmospheres.

The astonishing rapidity with which hydrogen passes through red-hot steel, even against the pressure of the atmosphere, has been demonstrated by Regnault. He connected a steel tube to a hydrogen-generating apparatus at one end, and to a barometer tube at the other; and after keeping the steel tube at a red heat for from 8 to 10 hours, with a stream of hydrogen passing through all the time, he suddenly shut off the gas, when, in about 18 minutes, a vacuum of 29 inches was indicated by the barometer gauge, the vacuum rising at a uniform rate. This power of diffusion seems to explain how under pressure, or other favourable mechanical conditions, the porosities in steel castings may be obliterated, without any obstacle being presented by the hydrogen or other gases imprisoned within them. The experiment made by Edison on the evolution of occluded gases from platinum wire, with the consequent hardening of the metal, have led the writer to the theory that the hardening of steel may be due to the escape of hydrogen or other occluded gases during the heating of the steel; the sudden cooling in water or oil would then prevent their re-absorption, and so enable the particles of steel to approach more closely to each other, thus rendering the metal harder and more dense. But if the view be correct, the specific gravity of hardened steel should be greater than that of the same steel before hardening; whereas it is well known that steel "swells" and becomes more bulky when hardened, and its specific gravity decreases. Caron has given very precise information on this subject. The writer, however, considers that the observed reduction of specific gravity is only apparent, and not real; and is caused by the increase of volume due to the fact that the outer layers of the steel, which cool first, are unable to contract, and thus, becoming stretched beyond their elastic limits, receive a permanent elongation which the subsequent contraction of the inner portions is not competent to reduce. According to this view the strains in a piece of steel hardened all over resemble those in a cast-steel ingot, as described by Chernoff. The outer layers are at first stretched, while the inner ones are compressed; but when the steel is quite cold, the outer layers are compressed and the inner ones stretched. If, however, a piece of steel is hardened from one side only—for example, by cooling it on a slab of cold iron having a thin stream of water running over it—the specific gravity will be found to have increased and not diminished; and, moreover, the bar will have become concave on the hardened side, showing that it has there contracted, and has consequently become more dense. This experiment the author has tried, and has thus been able to verify the statements of Regnault, that the specific gravity of hardened steel, when its particles are free from strain, is greater than that of the same steel before hardening. But the main difficulty surrounding the hardening and tempering of steel is to account for the gradual softening as the hardened steel is slowly heated again. This difficulty has been sufficient to upset the theories of Jullien and others; but the writer thinks that the new theory offers a ready explanation. As the hardened steel is heated the pores are opened; gas is again absorbed, and, when the tempered steel is again quenched, retains the molecules at that precise distance apart by which they were separated when the quenching began. The characteristic colours may also be explained by supposing that the opening of the pores of the metal causes changes on the surface of the steel sufficient to account for the change of colour. The theory by which it is commonly sought to explain these colours is that a film of oxide, forming on the surface of the steel, plays the same part as the thin surface of a soap-bubble, or as thin films of tar or oil floating on water. But, in the first place, the colours exhibited by steel are not iridescent, but each degree of hardness is indicated by a uniform colour; and in the next place the hues produced by thin films are only observed in transparent bodies, and are caused by the interference of rays of light, reflected partly from the upper and partly from the lower surface of the films. But oxide of iron, however thin, is never known to be transparent. Moreover, to produce a given tint, the thickness of the film must be some definite minimum quantity, or else an even multiple of that quantity: but the colours characterising particular degrees of hardness are constant, though produced under the most varying conditions of time and hardening medium; and it is difficult to conceive that the films should in all these cases always assume one of the several definite thicknesses necessary to satisfy the theory. It therefore seems more probable that a change of surface takes place, and that the colours are due to diffraction rather than to interference. Mr.

---

[*] Read before the Institution of Mechanical Engineers.

[†] Translated *in extenso* in the Metallurgical Review, New York, 1878, p. 457.

Hackney has suggested that the question might be settled by tempering in a reducing atmosphere, instead of in air; but such an experiment will not be conclusive, because the absence of the ordinary gases surrounding steel during the process of tempering may affect the surface of the metal.

A new and most sensitive instrument for ascertaining the molecular condition of metals has lately been placed in the hands of metallurgists in Professor D. E. Hughes' "Introduction-currents Balance." A description of this instrument will be found in the Proceedings of the Royal Society for May 1879 (vol. xxix, p. 59). By its means it is possible to detect extremely minute changes of structure, and to compare unknown specimens with any desired standards. In investigations connected with the molecular conditions of steel and other metals, chemical analysis is of comparatively little value, and is at best difficult, tedious, and costly to perform; whereas Professor Hughes' instrument appears to give the means of detecting not only chemical but also structural changes of very small amounts.

The above remarks, which the writer has been led to make by way of comment upon Chernoff's paper on the structure of cast-steel ingots, are intended to show the direction in which the inquiry into the hardening, tempering, and annealing of steel, promoted by the Institution, is tending. It is of the utmost importance to elicit the opinions and to take advantage of the experience possessed by many of the members; but the writer feels that much time and some expenditure of funds will be needed, before the changes undergone by steel in hardening and tempering are satisfactorily explained.

THE DEPHOSPHORISATION OF IRON IN THE BASIC-LINED BESSEMER CONVERTER*.

By M. A. POURCEL.

THE last time that I had the honour of laying before you the subject of dephosphorisation, I endeavoured to establish that in the basic converter, under the influence of a powerful oxidising action, the phosphorus is eliminated from the metal, and passes into the slag in the state of a phosphate of iron, having the formula PhO_5, 2FeO. This theory, accepted by some and rejected by others, is still a disputed point.

At the first glance, it may appear to you a waste of time to inquire in which state the phosphorus is eliminated. The question is assuredly of interest from a scientific point of view; but from a practical one, it seems of secondary importance, for the essential point of the process is the disappearance of the phosphorus from the metal, no matter in what state, provided it does disappear. On closer consideration, however, we see that this want of practical interest in the subject is only apparent. In fact, if the phosphorus of the pig-iron passes into the slag as a phosphate of iron, and as this latter compound cannot exist in a reducing medium, it follows that as long as carbonic oxide predominates in the intermolecular reactions, the phosphate is reduced to phosphide, and it is not until the carbon in the metal is reduced to a minimum that the phosphate can remain stable in the slag. The necessary consequence is the "overblowing," that is to say, the prolonging, by two or three minutes, of the admission of the blast beyond the point at which the ordinary Bessemer operation is stopped. If, on the other hand, the phosphorus of the metal passed immediately into the slag as a phosphate of lime, and as carbonic oxide exercises no reducing action on this body, it is apparent that the phosphorus and the carbon might burn simultaneously; consequently, the phosphorus would be eliminated in the course of the ordinary operation, and the overblowing become unnecessary.

It will be remembered that the special advantage claimed by Mr. Harmet for his method of repouring was to suppress the overblow.

All the united efforts of the inventors, of Mr. Richards, manager of Bolckow, Vaughan and Co., and of his colleagues, have equally tended towards the same end. Mr. Richards thought he had attained it by injecting lime through the tuyeres; and he says that half of the phosphorus disappeared from the metal, whilst the carbon still remained at 2·5 per cent.; but the practical result of this experiment must have been defective, seeing that the experiments in this direction have not been followed up. The overblow has thus been considered the weak point in the process of dephosphorisation in the basic converter. It is therefore not to be wondered at that I excited a crowd of objections when, in my first communication on the process I advanced the opinion: "That the overblow is and must remain the characteristic of the Thomas-Gilchrist method, because the phosphorus can only leave the metal and pass into the slag in the form of phosphate of iron." This amounted, in the opinion of some very practical metallurgists, almost to a condemnation of the process, if the inconveniences of the overblow were to remain such as they were in the first experiments I described. But such is not the case; and I was not blindly optimist when in June last I concluded my communication with the hope that by "carefully studying the chemical phenomena which took place in the process of dephosphorisation in the converter, the difficulties which stood in the way of its practical application would be surmounted."

To enumerate the difficulties resulting from the necessity of overblowing. In the first place, no sure index for stopping the operation; repeated stops had to be made for taking samples, which were hammered out and broken to ascertain whether the dephosphorization was complete. This mode of proceeding lacked certainty; it entailed a great loss of time, and might result in a cooling capable of compromising the operation.

Secondly, the necessity of increasing the manganese in the final additions, which was recognised by Mr. Richards himself in the course of the discussion at the London meeting. Further, the reabsorption of a certain proportion of phosphorus brought about by this addition; and finally, the excessive ebullition and projection of slag which accompany the final addition. The loss has never exceeded that of the ordinary process in the production of soft metal, and so cannot be reckoned among the difficulties attending the new process.

Such were the disadvantages of the overblow as shown by the experiments at Eston, at the time when the process commenced to furnish practical results. To point out the route traversed in the course of a few months, I will quote from results published by Mr. Massenez, manager of the Hörde Steel Works, in Westphalia, at the December meeting of the "Société de l'Union technique des Maîtres de forges," of the process as carried out at his works.

Mr. Massenez says that silicon is the enemy he repels and phosphorus the friend he seeks; in other words, the pig-irons he prefers would contain a minimum of silicon and a maximum of phosphorus. The difficulties experienced in Cleveland proceed from the absence of the wisdom shown by himself in perceiving that phosphorus, as a source of heat, could replace silicon with advantage. For the future his plan will be to increase the percentage of phosphorus in the pig; but, meanwhile, it will be well to examine the examples he instances in support of his opinion.

Pig-iron treated in the basic converter at Horde:—

	No. 1. per cent.	No. 2. per cent.	No. 3. per cent.
Silicon ..	1·08 ..	0·45 ..	0·72
Carbon ..	2·58 ..	2·82 ..	2·73
Phosphorus ..	1·04 ..	0·96 ..	1·04
Manganese ..	1·35 ..	1·04 ..	1·27
Sulphur ..	0·22 ..	0·16 ..	0·25

To compare these analyses with that of the Cleveland pig-iron used in the Eston experiments, a description of which I gave at the June meeting:—

	Silicon.	Carbon.	Phosphorus.	Manganese.	Sulphur.
Cleveland	3·03	3·20 ..	1·80 ..	0·45 ..	0·03

The principal difference, we observe, lies in the silicon, but also very appreciable in the phosphorus and manganese. The Cleveland contains less manganese, but more silicon and more phosphorus. We do not know what Mr. Massenez will do in the future, but at present, in spite of his great professions of friendship for phosphorus, he uses it with considerable caution, and is rather forgetful that he does not despise the manganese which, in a basic medium, is a calorific element not to be neglected. Moreover, before Mr. Massenez, Mr. Thomas, one of the inventors of the process, had at the London meeting very clearly expressed his opinion on the subject of phosphorus, which he believed might replace silicon as a calorific element. Mr. Ehrenwerth, professor of metallurgy at Leoben, in a somewhat elaborate study of the Thomas-Gilchrist process, published towards the end of last July, had given a table showing the respective quantities of phosphorus and silicon, which might replace each other in a given quality of pig, at the same time maintaining constant the heating power in the converter.

To return to Mr. Massenez's communication: "At Horde the full amount of additions required for a charge is introduced into the converter immediately after casting the previous charge. A small quantity of coke and rubble coal is mixed with them in the vessel, and the whole is then raised to a bright red heat by letting on a small amount of blast. The preliminary additions are reduced to burnt lime free from silica, and which should not contain even traces of water or carbonic acid. By this means projections of slag, &c., are completely avoided." Here the mode of operating is new. At Eston the preliminary additions were composed of lime and oxide of iron heated; at Horde the oxide of iron is suppressed, but the proportion in weight of lime is maintained at 20 per cent. of the charge. Why not 15 or 25 per cent. as occasion may require? Is it not the chemical composition of the pig to be treated, rather than its weight, which should be taken into account?

With pig low in silicon the first period is *nil*, the spectrum appears as soon as the blast is put on. There is no projection of slag, the flame is bright and has all the characteristics of a hotblow. When the flame drops, and the yellow ray in the spectrum is scarcely visible, the carbon being reduced to less than 0·1 per cent., the phosphorus has barely commenced to disappear.

The quantity of phosphorus found at this period in the three operations above mentioned were:—0·82 per cent.; 0·76 per cent.; and 0·74 per cent. It should be remarked that the point at which an ordinary blow for rail steel is stopped has long been passed when the carbon in the bath amounts only to 0·08 per cent. or 0·09 per cent. In general practice it is reached at 0·15 per cent. to 0·20 per cent. It is necessary to prolong the admission of the blast, and it is then only, after the drop of the bright flame, says Mr. Massenez, that dephosphorisation, properly speaking, commences by means of the overblow, the duration of which is proportional to the amount of phosphorus, and has varied at Horde from 100 seconds to 4 minutes. It is still usual at the conclusion of the overblow to take two samples, which are hammered out and broken, so as to judge by the fracture of the degree of dephosphorisation. But now there is an index almost absolutely reliable for stopping the blow, and that index is furnished by the appearance of the brown fumes at the mouth of the vessel which succeed the white, as soon as the phosphorus has been reduced to a minimum. This index was wanting at Eston, where I observed that dense fumes of oxide of iron were disengaged from the converter as soon as the overblow commenced, in precisely the same manner as in the treatment of hematite pig when the blow is prolonged after the disappearance of the spectrum. Might this possibly have been due to the previous addition of Blue Billy?

The addition of spiegel or ferromanganese takes place without any violent ebullition or projection of slag.

"No more manganese is added than in the ordinary process, nor is any reabsorption of phosphorus detected," brought about by the addition of the manganiferous pig. The cast steel contains 0·06 per cent. of phosphorus. These are the really new facts revealed by the communication of Mr. Massenez.

Thus, this large quantity of peroxide of iron dissolved in the metal, which at Eston necessitated the addition of an excess of manganese resulted in a great measure, from a previous addition of iron oxide in the form of Blue Billy. However, since Mr. Massenez gives us the weight of spiegel added at each of the above-mentioned operations, viz., 200 kilos. for 3200 or 3300 of pig, it is to be regretted that he omits to mention the percentage of manganese in the spiegel. Is it 10, 20, or 25 per cent? It is from 25 per cent on that spiegel passes into ferromanganese. Between these limits the proportion of manganese to pig-iron varies from 0·65 to 0·60 per cent. The margin is a large one. The mean 1·12 per cent. gives a very satisfactory result. Is the slight waste attributable to the low percentage of silicon? Mr. Gautier, who has presented a translation of Mr. Massenez's paper to the Society of Civil Engineers, wrongly attributes this view to him; and considers it himself a very natural one. Mr. Massenez says, indeed, with truth, that two parts of iron are required to neutralise one of silicon, and concludes from that, the less silicon there is to scorify so much less will be the waste of iron. But he is speaking here of the silica-lined converter, for which his theory, however, is very questionable, and not of the basic-lined converter to which it is not at all applicable.

It is easy to account for it from the following facts:—Mr. Stead, chemist at Middlesborough, and one of those who have been most occupied in the theory of the Thomas-Gilchrist process, gives, in a recent memoir read before the Cleveland Institute of Engineers, an interesting table of analyses made on samples of metal and slag corresponding to different periods, separated by very short intervals, of an operation in the basic converter. The analysis of the pig-iron used on that occasion is as follows:—

Carbon.	Silicon.	Manganese	Phosphorus.
3·57 per cent.	1·70 per cent.	0·70 per cent.	1·57 per cent.

The slag taken at the end of the first period, when the silicon in the pig is reduced to 0·28 per cent, and is consequently completely scorified, contains 2 per cent. of metallic iron in the form of protoxide, and 42·60 per cent. of silica.

(These analyses were made by Mr. Stead to test the truth of my hypothesis concerning the simultaneous departure of silicon and phosphorus in the basic converter; and his results conclude negatively. I am now of opinion that to bring about the simultaneous elimination of these two bodies it would be necessary to inject oxide of iron through the tuyeres, in order to obtain more intimate contact between the reagent and the phosphide of iron).

The final slag does not contain more than 7·10 per cent. of metallic iron. The analyses made by me and published in my June paper, show that in the treatment of a pig, the composition of which I have already given, containing 3·03 per cent. of silicon, the slag after 1 min. 30 sec. of overblow only contains 8 per cent. of iron, and after 2 min. 30 sec., 13·9 per cent. of iron.

Now in the operation, from which these slags come, a previous addition had been made of 7 per cent. (of the weight of the pig) of oxide of iron, "Blue Billy." To take an instance from the examples furnished by Mr. Massenez. The operation, which bears the number 67, was made with a pig containing:

Carbon.	Silicon.	Manganese.	Phosphorus.
2·58	1·08	1·35	1·04

The weight of metal charged inclusive of scrap and spiegel, is .. .. .. 3410 kilos.
Weight of metal cast out .. 3087 kilos.

Loss .. .. 323 kilos. = 9·45 per cent.

The following operation, No. 68, was made with a pig containing:

Carbon.	Silicon.	Manganese.	Phosphorus.
2·82	0·45	1·04	0·96

The silicon being in this instance from 55 to 60 per cent. lower than in the preceding. Let us see if the loss is correspondingly smaller.

Weight of metal charged, including scrap and spiegel .. .. 3.510 kilos.
Yield.. .. .. 3.126

Loss .. .. 384 kilos.
i.e., 10·90 per cent., or more than in the preceding case.

Are we to assume from this that the loss decreases as the silicon increases? No. The loss depends on more than one circumstance, and is attributable partly to chemical, partly to physical causes. It is interesting to consider how it is advisable, in order to ensure proper treatment of phosphoric pig, to reduce the silicon to a minimum, seeing that it does not affect the yield.

(*To be continued.*)

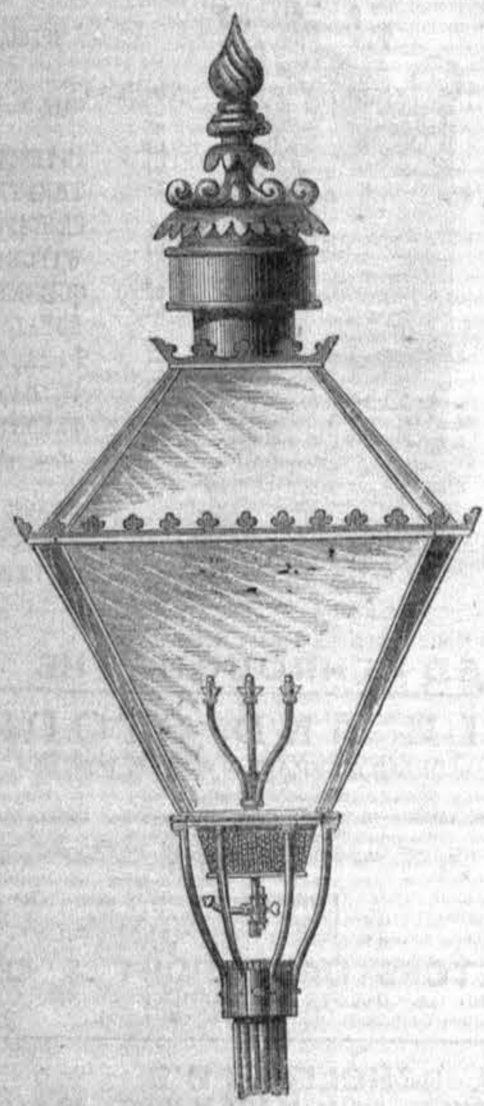
---

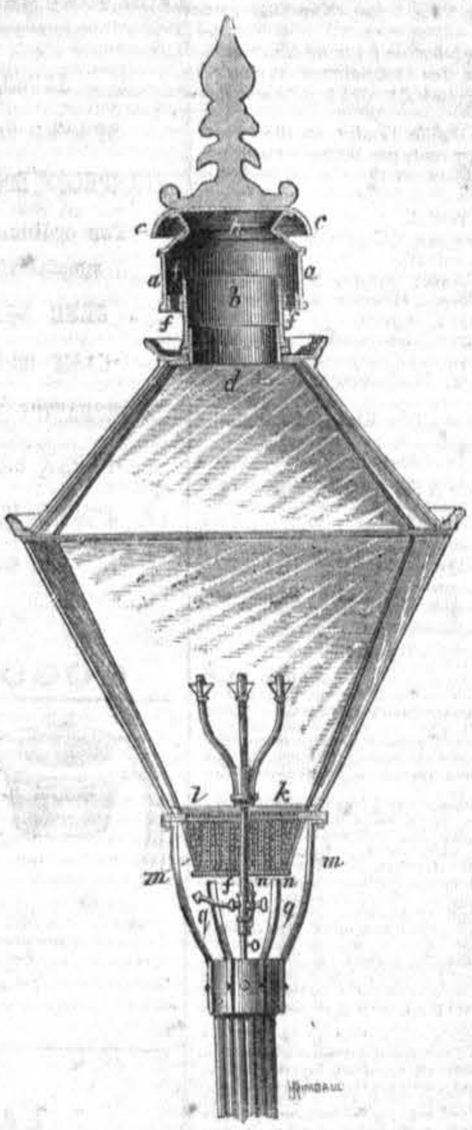
[*] Paper read before the Société de l'Industrie Minérale. March 6, 1880.

BIRKBECK INSTITUTION.—The City and Guilds of London Institute for the Advancement of Technical Education has voted £150, and the Clothworkers' Company 100 guineas to the building fund of this institution.

THE IRON TRADE AND RUSSIAN IMPORT DUTIES.—The Commission for revising the Russian metal tariff proposes very considerable changes in the duties on imported metal. The new tariff, which is almost certain to be adopted, is of immense importance for England. Many privileges have hitherto been granted to home manufacturers importing foreign in default of sufficient native material. Premiums and exemptions from duty for certain quantities of foreign metal necessary in their manufactures have resulted in various abuses, and it is proposed to abolish these privileges, with the exception of premiums accorded to native manufacturers in one or two cases. Notwithstanding the duty of 5 kopeks on foreign pig-iron, it appears that, owing to the privileges referred to, there was no less than 5,450,350 poods imported free of duty out of a total import of 6,395,697 poods in the year 1878. It has been proposed by the Commission to place a duty of 1 rouble 25 kopeks per pood upon agricultural machinery imported, which must naturally make a great difference to English importers of this class of machinery. The duty of 5 kopeks per pood on pig-iron is to be raised to 10 and 15 kopeks, and nearly all imported iron goods are to suffer a corresponding increase of duty. Steel, however, is to have a decrease from 80 kopeks to 20 kopeks per pood.—*Northern Echo.*

BRAY'S
Patent Lantern & Flat-Flame Burners.





THE FLAT-FLAME IS THE ONLY PRACTICABLE SYSTEM FOR STREET LIGHTING;

and, "in actual use," yields as much light with Common Gas, and more light with Cannel Gas, than any Argand System.

IMPORTANT NOTICE.

HAVING some time ago dealt with Mr. Sugg's statement that his street-lighting apparatus yielded "over 30 per cent." more light "over all others" in the market, in a manner that caused its prompt withdrawal, we had hoped that the necessity would not have again risen to defend ourselves against statements calculated to mislead Lighting Authorities and the Public.

At the Exhibition of Gas Lamps, recently held at Birmingham, an error in Mr. Sugg's favour—admitted to be such by the Experimenters, and known to be such by all those who have had to do with making comparative tests with these Lanterns—having been made in the test with the 200-candle power Lantern, it has been extensively advertised, without the correction accompanying it in Mr. Hunt's Report.

A correct estimate of Mr. Sugg's fresh advertisement will be gathered from the following facts, which he has been careful NOT to publish:—

1. Mr. Sugg has NOT noticed Bray's 80-candle high lighting power Flat-flame, which Mr. Hunt tested along with the other burners we sent, and which Mr. Sugg knows to have yielded 3·51 candles per foot; and he has omitted to state that this is a higher result than that produced by either of his 80-candle Argands, which was 3·26 and 3·41 candles per foot respectively; and this without deducting the 40 per cent. that the Argand necessarily loses "in actual use" (*see paragraph* 5). A large proportion of the street-lighting apparatus sent out by Mr. Sugg are 80-candle power, and have been freely advertised as yielding "over 30 per cent. more light than all others," &c.

2. Mr. Sugg does NOT state that all Bray's burners, with which he compares his own, in his advertisement, are of "MEDIUM lighting power," known to be such by the Birmingham authorities, and by Mr. Sugg, and distinctly stated to be such in all our lamp sheets. Therefore, in comparing his HIGH lighting power with our MEDIUM lighting power burner, without stating the fact, he takes an unfair advantage of a competitor, and the public are misled.

3. Mr. Sugg does NOT point out that there is but one (and that the least used) of the Argand, which he names, which shows a superiority of even 12 per cent. over Bray's above-mentioned 80-candle power burner, and this should be corrected as per paragraph 5.

4. Mr. Sugg does NOT mention that the Flat-flame Burners he exhibited were beaten by Bray's 80-candle power Flat-flame to the extent of 8 per cent. in one test, and 12 per cent. in another, but he distinctly states that his Flat-flame Burners "produced the highest result in illuminating power of all Flat-flame Burners present."

5. Nor does Mr. Sugg draw attention to the fact that the Argand cannot be made to yield "in actual use" the light it shows when tested by the ordinary photometer, which is the same in principle as that adopted at Birmingham. We state—and our utmost effort has not availed us to get Mr. Sugg to contest the points with us—that the lack of top and bottom light (as compared with the Flat-flame)—reduces the total all round yield by about 20 per cent.; and that the Argand burner cannot be governed, "in actual use," to yield within 10 per cent. of its best, because of the liability of the flame to smoke with the slightest increase of pressure when working to its full capacity. And a further deduction of 10 per cenr. must be made, because of the chimney becoming rapidly dirty, and permanently opaque by use if it does not happen to break.

6. Mr. Sugg also OMITS to mention that the Lantern in which his 200-candle power burner was tested was NOT the Sugg "Shadowless," of which there have been so many sold, but one designed by Mr. Hunt, which yields a much greater amount of light.

7. And while Mr. Sugg gives prominence to a result admitted to be erroneous by the experimenters (and has not accepted our offer to make another test with the same lamps), he entirely omits to mention the correction which accompanied the report from which he professes to quote. This correction showed that, when both apparatus were rated to consume exactly 46·75 feet of gas per hour, the lights were equal when the shadow meter was 73 feet 2 inches from Bray's Flat-flame Lantern, and 76 feet 10 inches from Hunt's Improvement on the Sugg Argand Lantern—this showing a difference of only 3 feet 8 inches; and from this result allowance must be made for the defects of the Argand when "in actual use," as per paragraph 5.

In view of the above, a proper estimate will be placed on Mr. Sugg's recent declaration that he "will have nothing to do with challenges," but "will continue to give, as he has always done, correct information of the results to be obtained from his burners and lanterns."

Extract from the *Leeds Mercury*, April 1st, 1880.

"At the meeting of the Leeds Town Council, March 31, Alderman Gaunt moved that the Council approve of the acceptance by the Corporate Property Committee of the tender of Messrs. George Bray and Co. for the supply of 21 new lamps, to be placed upon the pillars round the Town Hall. The committe had tested Sugg's and other lamps, and found Messrs. Bray's the best. It was intended to have two 200-candles power and two 100-candles power, and 17 round the hall of 80-candles power. Mr. Lynd, in seconding the motion, said that he had had an opportunity of seeing different lamps tested at Birmingham, and he was in favour of Messrs. Bray's."

Extract from the *Daily Free Press*, Aberdeen, Jan. 1, 1880.

"Judging of the merits of the light as they appeared last night, on-lookers seemed to be generally of opinion that between Sugg's patent and Bray's larger light at the corner of Union Buildings, Castle Street, there was no perceptible difference in the illuminating power. When the vital question of gas consumption is taken into account, it is found that in the Castle Street lamps there is a marked difference in the quantity of gas consumed; for, while 30 feet of gas are hourly burned in Sugg's patent lamp, only 20 feet are used by Bray's lamp during the same period."

[The above Lamps have Meters attached.]

Bray's Lanterns have been adopted by the Vestry of St. George (which includes WESTMINSTER), Hanover Square, London, for all the crossings and refuges of that important district, after a direct competition with the Argand system of lighting; and also by about 40 towns and vestries, after a similar competition in most cases.

GEORGE BRAY & CO., Blackman Lane, LEEDS.

THE SOUTH LONDON TRAMWAYS COMPANY.

INCORPORATED BY SPECIAL ACT OF PARLIAMENT,

42 AND 43 VICT., 1879.

By which the liability of Shareholders is limited to the amount of their Shares. Authorised Share Capital £70,000 in 7000 Shares of £10 each.

Subscriptions are invited for First Issue, 5000 Shares of £10 each.

Payable 10s. per Share on application; 10s. on Allotment, £2 per Share 1st July; £2 per Share 1st September, £2 10s. per Share 1st November next, and £2 10s. per Share 1st February, 1881.

The Contract will be let by Public Tender on the terms that Inrerest at the rate of 6 per cent. per annum be paid by the Contractor to the Shareholders on the Capital paid up until the Line is open.

DIRECTORS.

JOHN IRWIN, Esq., 79, Mark Lane, E.C., Chairman of the Thames-Haven Company (Limited).
J. PERCY LEITH, Esq., 8, Dorset Square, W., and St. Mary's Priory, Prittlewell, Essex, Director of the Southwark and Deptford Tramways Company.
HENRY DUNCAN, Esq., 1, Drapers' Gardens, E.C., Director of the City of Brunswick Tramway Company (Limited).
W. H. LETHBRIDGE, Esq., 18, Marlborough Road, St. John's Wood, N.W.
L. STAFFORD NORTHCOTE, Esq., The Elms, Lymington, Hants.

Bankers.—The ALLIANCE BANK, Limited, 1, Bartholomew Lane, E.C.
Solicitors.—MESSRS. ARGLES, RAND-BAILEY AND ARGLES, 85, Gracechurch Street, E.C., and 10, Rue Louis le Grand, Paris.
Engineer.—A. J. D. CAMERON, Esq., C.E., 9, Victoria Chambers, S.W.
Secretary.—H. CAMERON RICHARDSON. Offices—8, Tokenhouse Yard, E.C.

ABRIDGED PROSPECTUS.

The Tramways authorised to be constructed under the Special Act incorporating the Company (which received the Royal Assent in August last) will, with the Extensions for which application is being made in the present Session, form a system about eight miles in length (part of which is a double Line), passing through one of the most populous, active, and increasing districts in London, and will, in addition, serve an enormous population on all sides of the district.

The line already authorised commences at Plough Lane, Battersea. Passing Belmont (the extensive works of Price's Patent Candle Company), it is continued along the York and Battersea Park Roads, by Battersea Park (often visited by 15,000 persons at one time), and the two stations of the London, Brighton and South Coast, and London, Chatham and Dover Railways in these roads, and thence to a point near the Steamboat Pier, Nine Elms.

The population is of a class requiring tramway accommodation, and is increasing at a greater rate than any other Metropolitan district.

The Extension being applied for in the present Session received the sanction of the Metropolitan and Local Boards of Works, and the Bill has passed all stages of the House of Commons without opposition, and stands for the formal third reading at the sitting of the House.

It will be seen by the Map that by means of this system of Tramways the whole district is put into direct communication with no less than seven important Railway Stations, Clapham Junction (where over 850 passenger trains arrive and depart every day), Wandsworth, Battersea, York Road, Battersea Park Road, Queen's Road, and Wandsworth Road. These stations belong to different railways communicating with the Termini at Waterloo, London Bridge, Cannon Street, Ludgate Hill, Victoria, and the Crystal Palace, and in fact with every railway system in London, North and South of the Thames.

The lines will be set with steel rails and granite setts, firmly embedded on a thick layer of concrete, and in the most durable manner, so that the large outlays for renewal rendered necessary in the earlier Tramways will be avoided.

None of the conditions requisite for the complete success of a Tramway are absent from the present enterprise, and the Directors believe that the Company will be a more than usually prosperous undertaking.

The Act incorporating the Company, the Bill for the Extensions, and the Plans and Sections of the whole of the Tramways, can be seen at the Solicitor's and the Company's Offices.

Copies of the Prospectus and Forms of Application can be obtained at the Offices, or from the Bankers and Solicitors of the Company.

WIRKSWORTH, DERBYSHIRE.
TO IRONMASTERS, STONE MERCHANTS, CONTRACTORS AND OTHERS.

George Marsden is instructed by the Mortgagees to Sell by Auction, at the Red Lion Hotel, Wirksworth, on MONDAY, 24th May, at 2 o'clock in the afternoon, subject to conditions to be then produced, a VALUABLE RESIDENTIAL ESTATE, known as THE LEES, WIRKSWORTH, with several fields of meadow and pasture-land adjoining, occupying an area of 8a., 2r., 10p.; several other lots of accommodation land; 16 dwelling houses, shares in two cottages and three fields, and accommodation land having an area of 13a., 1r., 22p., and also a highly valuable and practically inexhaustible

LIMESTONE QUARRY,

of an average height of about 300 feet of stone of great purity and insurpassable in quality for fluxing glass and chemical purposes, and stone and gravel for asphalting. TWO LIME KILNS, capable of turning out 200 tons per week of lime for agricultural, building, gas purifying, and other purposes, having a constand and increasing demand, together with the Steam Crane and Boiler, Blake and Marsden's Stone Crusher, with Engine, Boiler and all other

FIXED PLANT AND MACHINERY.

The Quarry is connected with the Wirksworth Station on the Midland Railway by a tunnel of main line dimensions, laid with rails, points, and all requisite sidings. Five workmen's cottages, workshops, and offices, comprising a total area of 10a., 3r., 13p., forming a compact going concern, capable of indefinite extension and certain to yield large returns.

Particulars, with plans of the said property, will be ready on May 13th, and with tickets to view the house, grounds and quarries, may be had on application to the Auctioneer, Wirksworth, or at the offices of Messrs. LEECH, SMITH AND BROUGHALL, Solicitors, St. James's Street, Derby.

STENCIL PLATES.

TO ENGINEERS, AND ALL WHO DRAW PLANS.

TO BE SOLD, a MAGNIFICENTLY EXECUTED SET for LETTERING PLANS, &c. The SET consists of TEN COMPLETE SETS of ALPHABETS, plain, shaded, and ornamental; FOUR SETS of FIGURES in various styles; and FIFTY PLATES of all the principal words used upon Engineering Drawings, including Scales, Points, Corners, &c., in a mahogany case with Brushes. Price for the whole, 30s.

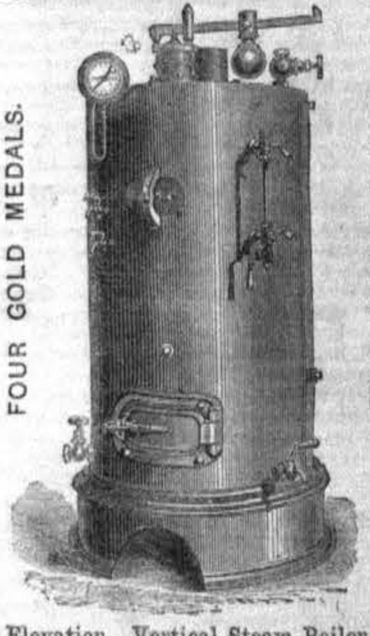
Apply to Mr. G. BAKER, 22, Orpingley Road, Hornsey Road, London, N.

EDWIN LUMBY AND SON,

WEST GROVE WORKS, HALIFAX,
Patentees and Manufacturers of Wrought Welded Boilers.
FIRE AND BURGLAR PROOF SAFES, &c
GOLD MEDAL, PARIS, 1878: SILVER MEDAL, PARIS, 1878.
THE ONLY GOLD MEDAL AT ANY INTERNATIONAL EXHIBITION FOR WELDED BOILERS.

SAFES,
STRONG ROOMS,
FIREPROOF DOORS, &c.,
For ordinary and special risks.
DEED BOXES,
CASH BOXES,
DESPATCH BOXES,
PAPER BOXES,
JEWEL BOXES,
&c., &c.

FOUR GOLD MEDALS.



FOUR SILVER MEDALS.

Elevation. Vertical Steam Boiler.

SPECIALTIES IN BOILERS.

GOLD MEDAL EXCELSIOR.
INVINCIBLE.
TRENTHAM CORNISH.
CRUCIFORM.
WITLEY COURT.
QUEEN'S.
ROYAL ALBERT.
PARAGON.
VULCAN.
TERMINAL END,
And others of acknowledged merit.]
RANGE BOILERS,
RIVETTED BOILERS,
COPPER BOILERS,

GOODS SUPPLIED THROUGH THE TRADE.

NOZZLE AND STOPPER

FOR ORDINARY AERATED WATER BOTTLES,
(Horner's Patent).

The only Patent for utilising old Bottles. Converting them into Patents, saves Corks, Wire and Labour.
No Leakages. Easily fitted to any Bottle. Nozzle and Stopper can be used again if Bottle breaks. Cost saved in one season.

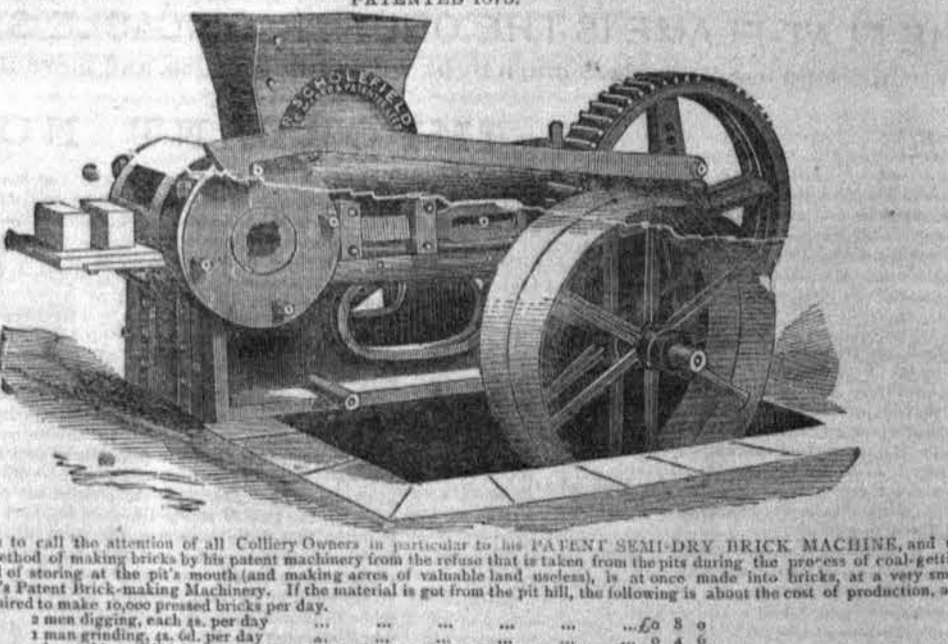
HOME PRICES.	
Nozzles, Stoppers, and Washers,	14s. per gross.
Extra, if Nickel Plated Nozzles,	6s. „
Bottling Machines, £5 5s., £10 10s., £16 16s.	
Royalty, £5 5s. per annum.	

EXPORT PRICES.	
Nozzles, Stoppers, and Washers,	16s. per gross.
Extra if Nickel Plated Nozzles,	6s. 6d. „
Bottling Machines same as Home.	
No Royalty.	

SOLE PROPRIETORS—DAVENPORT & CO.,
SODA-WATER AND ICE-MAKING MACHINISTS, 99D, HIGH HOLBORN, LONDON.
Illustrated Catalogues Post Free to all parts of the world.

R. SCHOLEFIELD'S
LATEST PATENT BRICKMAKING MACHINE.

PATENTED 1873.



R. S. begs to call the attention of all Colliery Owners in particular to his PATENT SEMI-DRY BRICK MACHINE, and the economical method of making bricks by his patent machinery from the refuse that is taken from the pits during the process of coal-getting which, instead of storing at the pit's mouth (and making acres of valuable land useless), is at once made into bricks, at a very small cost, by R. S.'s Patent Brick-making Machinery. If the material is got from the pit hill, the following is about the cost of production, and the hands required to make 10,000 pressed bricks per day.

	£	s.	d.	
2 men digging, each 4s. per day ...	0	8	0	
1 man grinding, 4s. 6d. per day ...	0	4	6	
1 boy taking off bricks from machine, and placing them in barrow ready for the kiln, 2s. per day ...	0	2	0	
1 boy greasing, 1s. 6d. per day ...	0	1	6	
1 engine-man, 5s. per day ...	0	5	0	
1 man wheeling bricks from machine to kiln, 4s. 0d. per day ...	0	4	0	
Total cost of making 10,000 pressed bricks ...	1	5	0,	or 2s. 6d. per 1000

(SETTING AND BURNING SAME PRICE AS HAND-MADE BRICKS.)

N.B.—Where the material can be used as it comes from the pit, the cost will be reduced in digging.

As the above Machinery is particularly adapted for the using up of shale, bind, &c., it will be to the advantage of all Colliery Owners to adopt the use of the said Brick-making Machinery.

The Machines can be seen in Operation at the Works of the Sole Maker and Patentee daily.

PATENT BRICK MACHINE WORKS, NEAR VIADUCT, BURLEY VALE, BURLEY, NEAR LEEDS.

London Water Supply—A Public CONFERENCE to discuss this subject will be held by the SOCIETY OF ARTS on MONDAY, the 24th inst., and succeeding days. As soon as the arrangements are complete they will be published. Programmes, as soon as ready can be had on application to the Secretary, Society of Arts, Adelphi, London, W.C.

By order,
H. TRUEMAN WOOD,
Secretary.
Society's House, Adelphi, W.C.

Spring Hill, Birmingham, Brass and COPPER ROLLING-MILLS, BRASS AND COPPER WIRE MILLS.

BRASS AND COPPER LOCOMOTIVE, MARINE, AND GAS TUBE MILLS, CARTRIDGE METAL-MILLS.

Proprietors:
GLYDON, SHORTHOUSE AND GLYDON.

WHOLESOME HOUSES.

BANNER'S PATENT SYSTEM OF SANITATION.

BANNER'S PATENT VENTILATING COWL AND TRAP.

No house should be without one of the latter in the basement, and one of the former fixed on the Soil Pipe carried above the roof, with a proper inlet for fresh air.

OPINIONS OF THE PRESS.

"ALTHOUGH there are appliances and arrangements by means of which sewer-gases may be effectually prevented from entering houses, they still do so in the great majority of dwellings, both in town and country, including the metropolis."—"Society of Arts."

"The system devised by Mr. Banner is as near perfection as may be; nothing better need be desired. By means of this cheaply-made and otherwise simple apparatus the foul air in any shaft will be continuously extracted."—"Sanitary Record."

"The word 'impossible' has ceased to exist in the vocabulary of the sanitary reformer; if a prevalent evil ought to be removed, it can be removed."—"Times."

"Ventilate! Ventilate! Ventilate!"—"Public Health."

"There is a difficulty in getting sewer-gas to ascend a long perpendicular pipe, while in some conditions of the atmosphere there may be a down draught instead of an upward current; and it is to overcome this that the cowl is introduced. One lesson which Mr. Banner has learned, namely, that to make a ventilating pipe of constant avail air must be introduced at the bottom, is of itself a boon of value."—"The Builder."

"We believe Mr. Banner's system of sanitation will make any house absolutely safe from sewer gas or noxious odours of any description from the drains or closets. We have no doubt that some sanitary reformers will declare that such a result is impossible. Our answer to such objectors is—do as we have done; investigate the novel plan introduced by Mr. Banner, and judge for yourselves."—"Architect."

"A thorough current of air is constantly maintained by an inlet placed just above the trap, and an outlet above the roof, to which is annexed the cowl, preventing any down draught. A velocity of 510 feet per minute was registered by an anemometer under very ordinary circumstances."—"Building News."

"Mr. Banner's system thoroughly effects what it proposes—namely, to render houses wholesome which are now mere deadly fever-traps, whether they be mansions in Belgravia or cottages in the suburbs."—J. P. Seddon, F.R.I.B.A.

"Mr. Banner's system fulfils all the conditions specified in the contract. There is no foul air generated. The several currents in the soil-pipe, in the drain and in the large sewer—a channel of 350 feet in length—have uniformly been found to be flowing in the right direction whenever they have been tested (and this has been done repeatedly); while no inconvenience has arisen from the removal of the numerous traps and other apparatus which were thought to be the only safeguards of our water-closet system."—"Guy's Hospital Gazette."

"It is a peculiar merit of the combination that the passage of the air must be upward, not downward . . . . The atmosphere at the time of our visit to Guy's Hospital was dull, aqueous and almost motionless, yet, by testing, we found there was a decided inward current at the inlets. The system introduced by Mr. Banner has now undergone a crucial test, and can only be looked upon as a great *fait accompli*."—"Metropolitan."

"The conclusions I have come to after a considerable time spent upon their study is, that they (Banner's Sanitary Appliances) are the best media extant for the work which they are intended to compass, that I can confidently recommend them, and that they ought to be specified by architects generally."—"Sanitary Arrangements for Dwellings."

TESTIMONIALS.

Baron's Court, Dec. 6th, 1879.

"SIR,—I am glad to give my testimony of the complete success of the system which you have inaugurated at Baron's Court and at my London residence, Hampden House, for the sanitary security of the drain, and I see no reason to doubt its complete success for the future. The system seems to be both simple and effective, and one which is not likely to suffer any derangement. I have to thank you for all the care and attention which were bestowed during the progress of the works, and for the very efficient way in which they were carried out under considerable difficulties here, as to limited time and other circumstances.

"Faithfully yours, "ABERCORN."

"January 16th, 1880.

"In reply to your letter I have much pleasure in stating that I am quite satisfied with the Banner System of Drainage and the Ventilation of Drains, Soil-pipes, &c., as carried out at Burley House. The works have been completed for a considerable time (two and a-half years), and all appears to be going on satisfactorily.

"Your obedient servant, "EXETER."

"46, Belgrave Square, Nov. 27, 1879.

"In reply to your inquiry, I have pleasure in stating that I am quite satisfied with the Banner System of Sanitation, embracing ventilation of drains, soil-pipes, &c., as it has been carried out at my Irish seat, Headfort House, and Park Lodge, Virginia. I know that the work at Headfort was a a difficult one, and saw it at various stages as it progressed. I am not only satisfied with the resultss worked out by your system in a sanitary point of view, but also consider the charge made for the important work as done very reasonable. I feel I have now a security against the ingress of sewer-gas into my houses, and consequent illness, which I never before had, although I had incurred from time to time large outlays to effect this most desirable end. "HEADFORT."

"95, Eaton Square, Dec. 13, 1879.

"Lord Erne has much pleasure in bearing testimony to the efficiency and thoroughness of Mr. Banner's system of Sanitation. Nothing can be more perfect, both in theory and practice, than the system when carried out in its entirety. The cause of much unpleasantness and even illness at Crom has now been quite removed; and, as far as a year's experience can prove anything, he is quite willing to recommend it as a perfect cure, always provided the work is well carried out."

"Forest Lodge, Binfield, Dec. 14, 1879.

"I am very much pleased with your Ventilating Cowls—there is not the slightest smell anywhere. I have recommended your system to many of my friends, who intend to carry it out.—I am, &c., "WARWICK MOORSHEAD."

"Kylemore Castle, Dec. 5, 1878.

"I beg to enclose a cheque for the sanitary works executed at Kylemore Castle. I am quite satisfied with the charges for the extensive works that were necessary in so large a building; and now that the Banner system has been completed here, I wish to say how much delighted I am with it. Like many other great discoveries and inventions, the wonder is that it was not thought of before; and now that you have brought it to practical application, one is surprised at the simplicity with which it can be carried out. Many persons have advocated the ventilation of sewers, &c., and in one way or another everybody has tried to do it. To reduce the formation of mephitic gases to the minimum, and to prevent altogether the accumulation of any gas that may be formed, constitutes, I suppose, the key-note of your system; and admirably it is carried out. I had done everything I could to perfect the drainage and sewerage here; we had elevation of the house, giving plenty of fall, lots of water, and a large tank for a receptacle, pipes went up from every soil-pipe of the closets, the cess pool was also supplied with a ventilating-pipe, carried into the wood, far from the house. All in vain; those abominable D traps in the closets, and the closed drains could not be ventilated by any such devices; but now that openings have been made in them, and your powerful, though simple cowls, have been adjusted to the ventilating-pipes from the closets, I venture to say that there is not, and cannot be, any accumulation of gas, because hardly any gas can be formed, and whatever is formed passes rapidly up, and escapes at the cowls. I have now a feeling of comfort and security, as regards the healthiness of the house, which I never had before. It is very doubtful whether sewer-gas can form at all in pipes and drains ventilated on your system; but it is very certain that if there is any formation il must find its exit at the top of the building, and be dissipated in the atmosphere, where it can do no harm. My house is now perfectly pure, and I have no doubt we shall escape many evils which fell upon us under the old system of traps, and bottling up of gases, contrary to all the laws of nature. I will only now add that the alterations you designed and made have proved most satisfactory, and that the facility with which the appliances can be inspected and seen to be in order constitutes a material advantage in the System. I have troubled you with a longer letter than I intended; but when once I get on a matter of sanitation my pen runs away. Again thanking you for the valuable work you have done here.

"I am, &c., "MITCHELL HENRY."

"Hanton Hall, December 13, 1879.

"I was very much pleased by the way in which the Banner System of Sanitation was carried out with regard to my house and drains, and consider that it was a complete success.

"E. HENEAGE."

"Monk Tower, Lincoln, Nov. 17.

"As far as I have had experience in the Banner System of drainage, it has answered perfectly at Osberton, but of course a few months is hardly sufficient test. It appears, however, that it is impossible with such an arrangement for sewer-gas to find its way into the house. "F. J. S. FOLJAMBE."

"Bedford House, Streatham, Dec. 16.

"The sanitary alterations carried out at my house have given us complete satisfaction, and entirely removed the offensive smells of which we so frequently had to complain before. The system you have introduced seems altogether the most perfect I have anywhere seen.

"Faithfully yours, WM. GRANTHAM."

"Moreton Pinkney Vicarage, Jan. 31, 1880.

"The sanitary work done by you at my vicarage in 1877 has proved quite a success, and I never lose an opportunity of recommending your system. "N. D. WHITE."

"I have had, I am sorry to say, too much experience as to the absolute necessity of attention and alteration being required in the drains and ventilation, even in the mostly recently constructed and costly mansions. "ROBERT RAWLINSON, C.B."

"I believe in your cowls, and I think that probably I am as impartial a judge as can be had, yet I candidly confess that if I knew of a better cowl I would employ it.

"H. H. COLLINS, F.R.I.B.A."

"The Banner system has now been in use at Guy's Hospital during all winds and al weathers, and is found to continually withdraw from the drains, as well as from the soil-pipes, sluice-pans, &., of the different wards, all foul air or gas, and to replace it entirely with a continuous current of fresh air; and I believe it to be worthy of universal adoption.

"ARTHUR BILLING, F.R.I.B.A."

"Your System at the Royal Infirmary, Ryde, continues to act perfectly, and I am applying it in all cases where I have the opportunity.

"THOMAS HELLYER, Architect to the Infirmary."

"I have no hesitation in saying that Mr. Banner's System works admirably, and that he has succeeded in rendering a house absolutely secure against that most insidious of enemies, sewer-gas. I must say, in justice to Mr. Banner, that the greatest possible credit is due to him for having succeeded in solving a problem which has hitherto baffled all the combined talent of the best sanitary authorities of the day.

"MAJOR H. C. SEDDON, R.E."

"St. Michael's, Clapham-rise, Feb., 1880.

I have the pleasure to enclose cheque in discharge of your account. Rayfield has done his work to our entire satisfaction. With regard to the success of the Cowls it is difficult to speak with the absolute certainty in the present almost dilapidated state of the Church; that they do most thoroughly sweep and cleanse the Church of the vitiated atmosphere which used before to poison me well-nigh to the death every Sunday there can be no manner of doubt; the only question is as to their effect upon the draughts, some thinking that they have increased these, while others (and these latter the best judges) are of opinion that they have considerably diminished them. I hope we may see our way to having the inlets made, and then I shall be able to let you know exactly and fully what we think of your simple and yet admirable and clever invention, to whch I wish all possible success.

(Signed) "M. F. BEGBIE."

"Hove, Brighton, Feb., 11, 1880.

"I enclose you copy of notes of experiments made here with your patent Cowl. They show conclusively that a given volume of air passing through the annular portion of the Cowl at a velocity of 18·72 miles per hour will draw through the inside pipe another volume of air which is equal to 29·12per cent. of the first-mentioned volume.—Yours faithfully,

(Signed) "J. B. PARDON."

Thus it is Guaranteed that if the wind at roof level be blowing at four miles an hour, which is only about one-third its average velocity, that fresh air is drawn in at the inlet if it be properly arranged, and out by the Cowl through any house drain or soil pipe in less than one minute.

The system is substantially recommended by the Local Government Board, and should be universally adopted.

FOR PRICES AND PARTICULARS ADDRESS

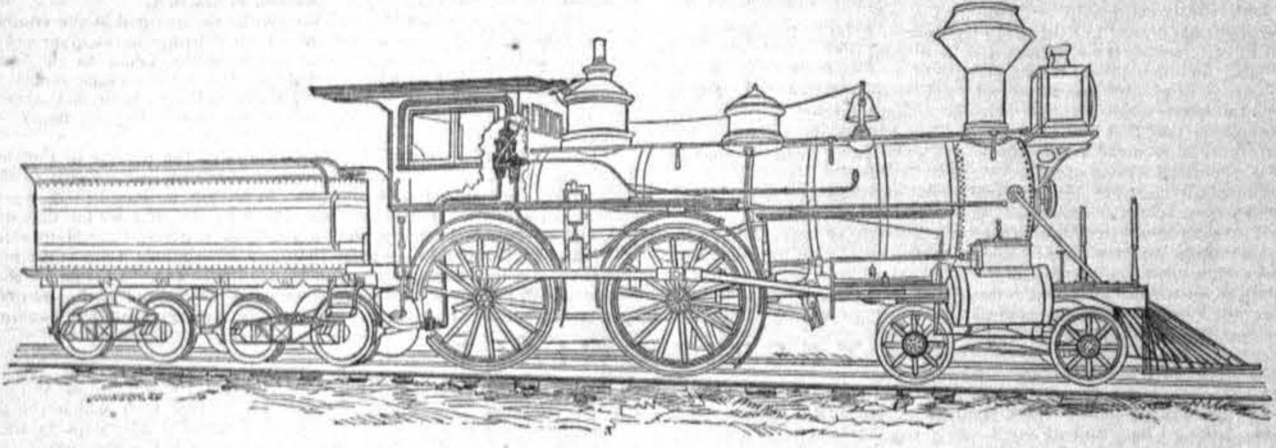
BANNER BROTHERS and Co., No. 11, Billiter Square, London, E.C.

ONLY GOLD MEDAL FOR INJECTORS, PARIS EXHIBITION, 1878.

THE HANCOCK INSPIRATOR.

CAN BE PLACED HIGH ON THE ENGINE, DIRECTLY UNDER THE DRIVER'S CONTROL.

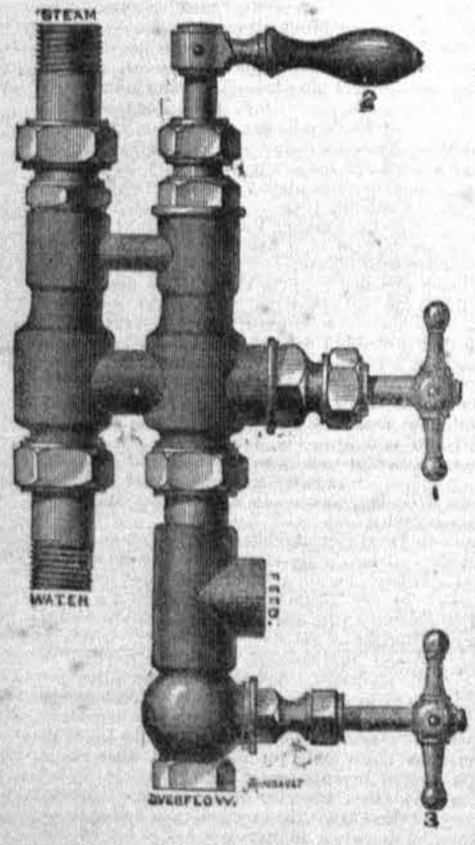
CONNECTIONS ABSOLUTELY TIGHT. NO STEAM OR WATER ON THE FOOT-PLATE.



ENTIRELY RELIABLE FOR FEEDING THE BOILER ON THE ROAD, AS WELL AS WHEN THE ENGINE IS AT REST.

WORKS EQUALLY WELL WITH HIGH OR LOW STEAM.

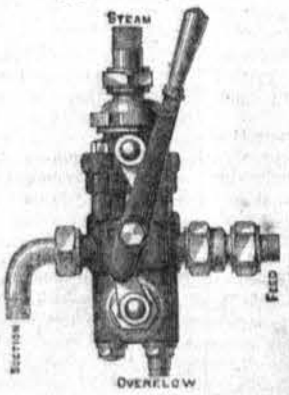
C Pattern,
FOR STATIONARY BOILERS OR FOR USE AS A PUMP.



DESIGNED SPECIALLY FOR PLOUGHING & TRACTION ENGINES, CONTRACTORS' LOCO'S., &c.
A Pattern.

THE ONLY FEEDER THAT WILL WORK ON THE ROAD.

NO ADJUSTMENT WHATEVER.



OPERATED BY THE MOVEMENT OF A SINGLE LEVER.

OVER 9000 IN USE.

Best Boiler Feeder Known.

COMBINED PUMP AND INJECTOR.

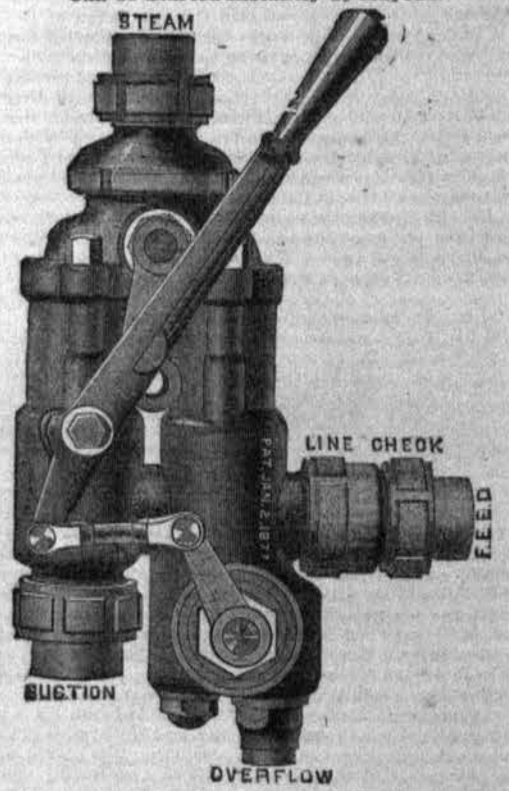
All Sizes Lift Water 25 Feet, and work with Guaranteed Certainty.

No Adjustment, Automatic or Otherwise, for the Varying Steam Pressure.

NO MOVING PARTS.

Will work hot or cold water.

B Pattern.
ADAPTED FOR STEAMSHIPS, LAUNCHES, YACHTS, TUGS, LOCOMOTIVES, &c.
Works with Reliability while the Vessel is Rolling and Pitching.
Can be Started Instantly by Anyone.



THE HANCOCK INSPIRATOR CO.,

35, Queen Victoria St, London, E.C., and 41, John Dalton St., Manchester.

BRISTOL : MESSRS. G. K. STOTHERT & CO.
LEEDS : „ J. & W. SNOWDEN.
NEWCASTLE : „ MENZIES & BLAGBURN.
LIVERPOOL : „ ALISON & GALLAWAY & CO.
PORTSMOUTH „ VOSPER & CO.
GLASGOW : { MESSRS. ALLEY & MACLELLAN.
„ JOHN DONALD & SON.
EDINBURGH : „ MILLER & HERBERT.
BELFAST : „ J. & S. SCOTT & CO.
DUBLIN : „ BEWLEY, WEBB, & CO.

only Mr. Richards should have the necessary information, but that the whole of the members should have the entire information that he could obtain and give them. Mr. Bell, he was afraid, had rather misconstrued what he had said as regards the loss of life. The three charges that had been very carefully analysed showed a loss of 10·7, whereas he said in the general practice they were losing 15 per cent. That required possibly a little more explanation on his part, or otherwise Mr. Bell might carry the weight with him. At the time they were experimenting trade took another turn, and they were forced to force the working by putting an increased quantity into the small converters, 4 feet in diameter. Instead of putting in 3 tons 8 cwt. his fellows were melting down as much as 4 tons 4 cwt., and the result was, in order to get an ingot or two more, they were blowing out four or five per cent. more metal. If they took into consideration the size of the converter he had just mentioned, then it would be very clear to them that, when they put in as much as 14 cwt. of lime and 4 tons 4 cwt. of molten iron, there was very little room for the metal to boil in, and consequently it boiled over. If they reduced the charges down and worked economically they would not have not have 11 per cent. of loss. Mr. Holley had spoken of irregularity of phosphorus. They had taken about 4 or 5 cwt. for the analyses of the phosphorus, and then found that a certain amount of regularity was there, but the irregularity was always within bounds of those mentioned in the paper, and that was from 1·08 to 1·04. They found that this irregularity had nothing whatever to do with the saleability of the goods. The rails with this amount of phosphorus were easily saleable, and he might also mention, although it appeared to be blowing the trumpets of those engaged in dephosphorisation, that the old Bessemer engineer was blowing away at a constant of phosphorus and never altered it. Therefore, there was no particular honour to him because he did not get it. The phosphorus was as it was, and they were working at an element of phosphorus, and had achieved some results which he hoped would be in the course of a few months to Mr. Bell's satisfaction. Mr. Bell also mentioned that the carbon was so low; well, they would see that the specimens they had shown there were low, but they had only been what had been made for certain qualities. If Mr. Bell wished an iron with ·5 of carbon and a steel ·5 of carbon it was easy enough to achieve that. This particular class of steel was what one would term a carbon steel when blowing for ingot iron. When working on a pig in an acid converter with three or four manganese they had the greatest difficulty in getting in carbon at all. They got a slag with such a large quantity of oxide in it. The carbon was reduced in passing through the slag into the metal, the old method they had used in Horde, and they must call it manganese as its virtue relied upon the manganese and not the carbon. The Thomas-Gilchrist process appeared to him to be a purely carbon steel. Mr. Bell had also spoken of the length of life of rails, taking them into consideration with the amount of carbon they contained. These rails with a low amount of carbon and a half per cent. of manganese in them, ultimately they gave such good results. They had had little or no amount of replacing in spite of the twelve years' guarantee. Mr. Adamson had spoken of their not exactly coming up to the standard of requirements as far as the details given there. Well, he might be possibly right, but as opinions differed so they were forced to work according to the opinion that dominated with them in their part of the world. A great number of the German engineers, who studied metallurgical subjects, as well as those who were connected with railway institutions, determined the ductility of the metal by the amount of contraction on it, and therefore the elastic limit was very seldom determined, and therefore it had been forgotten. Then the president had not quite understood what he had stated about the large vessels. He mentioned, he believed, that their large vessels were not giving such good results as the smaller ones, and he mentioned that in the part of the paper where he was speaking of the block of the nose, the small converters did not block at all. He did not like for it to go abroad that larger converters were doing badly in juxtaposition with the small converters, as it was only the large converters in this case.

Mr. Cooper, in reply, said that Mr. Richards had reached the question of waste. They had not very elaborate figures to lay before them on this question, but in the six weeks ending March 27th they got 541 tons 7 cwts. of ingots out of 630 tons 17 cwt. of pig, giving a waste of about 15 per cent. He attributed their inability to get out as much as their American friends to the fact that they had faulty and antiquated arrangements. Messrs. Snelus and Thomas had both raised the question of working the pig without manganese, but in all cases where they used a pig low in manganese there were reactions on adding the spiegel.

SOCIETY OF ENGINEERS.

THE TAY BRIDGE.

At a meeting of the Society of Engineers held on Monday evening, May 3rd, in the Society's Hall, Victoria Street, Westminster, Mr. Joseph Bernays, President, in the chair, a paper was read by Mr. Graham Smith on "The Design and Reconstruction of the Tay Bridge." In opening his subject the author gave a brief history of the structure from the passing of the Bill in 1869-70 until its failure on the 28th December, 1879. He then went on to point out that although no subject had had a larger share of public attention during the past ten years than the progress and effect of the opening of the Tay Bridge, that yet no engineering work of magnitude had been carried out during recent years about which so little real and definite information had been published. He then gave such particulars concerning the structure as he was able to obtain from the various sources within reach, and stated that a short-span single-line bridge of the Tay Bridge description should be sufficiently strong to carry a train of a length exceeding that of any span and sufficiently stable to resist all forces which might be brought to bear with such a train running or standing upon it. He pointed out that although stability and strength were entirely distinct yet that they were inseparable in a trustworthy structure, as if amply stable it might fail for want of strength, and if amply strong, fail for want of stability. After detailing the various points and considerations which it was necessary to ascertain and weigh in arriving at the force which would be required to overturn the Tay Bridge, he showed by calculation that 32·7 lb. of wind distributed over the side of the structure with a train upon it would be sufficient to overturn the structure if not bolted down to the masonry. He then showed that if the bolts had been attached securely to a sufficiently large mass of masonry that they were capable of enabling the bridge to sustain a further wind-pressure of 40 lb. per square foot, that was providing the shoes and columns were strong enough to allow of the bolts exerting their whole power. However, as the bolts were only attached to two courses of masonry their efficiency was reduced from enabling the structure to resist a further 40 lb. to 1·3 lb. of wind, so that the total amount of wind-pressure required to overturn the bridge with a train upon it was only 34 lb., and without a train 51 lb. The calculations which gave these results were based upon the hypothesis that the lee girder and cross bracing was entirely protected by the windward girder, and the piers sufficiently strong to turn on its lee cutwater column. They were consequently maximum results which could never be reached in practice, however; and any endeavour to ascertain how much less wind-pressure per superficial foot would be required to overturn the bridge was, he remarked, perfectly useless, inasmuch as the strength of the piers was entirely dependent upon the strenth of the bracing, a point which no amount of calculation could ever determine, owing to the design of the piers and the absence of exact particulars as to the state of the bracing at the time of the accident. He then went on to remark that it was needless to try to arrive at more accurate results, inasmuch as those which never could be reached were still less than the estimated force of the wind. Although it might at first sight appear that the remaining portions of the bridge being lower and of less span, that they would be more stable; such was the case only to a limited extent without a train, the maximum force of wind required to overturn the 145 feet spans would be 76 lb., and with a train 37 lb. Cut-water columns had an undue portion of the weight to support, and had to resist the greater portion of the side pressure, owing to the shape of the piers. After entering into some calculations connected with the bracing he went on to say that it was as logical to endeavour to ascertain the exact manner in which each portion of the bridge fell as it would be to speculate as to the manner of falling of a set of nine-pins. It was reasonable to suppose that the portion with the train upon it was the first to go; as its stability with a train was much less than when without a train, the remaining portion would be pulled down by the falling ironwork assisted by the wind, and each portion may have fallen in any one of many ways. In considering the question of restoration, he stated that the present bridge could not be reinstated as a single-line bridge without rebuilding nearly the whole of it from the bed of the river, and that therefore the £120,000 which had been set aside, although possibly sufficient to restore the bridge to its state before the accident, was quite inadequate to render the bridge safe for a single line. He stated that the proposal to build a new bridge alongside the old structure, and brace the two together would be somewhat hazardous, inasmuch as any inequality in settlement of the foundations would render the bracing useless, and might induce strains in the piers and bracing, the amount of which it would be impossible to determine. He therefore proposed to build new piers in line with the old piers, place a girder from one to the other, and on this girder rest the main girders carrying the railway. As the new piers would be designed to take all strains due to side pressure, the old piers might be utilised in their present form, and the old girders employed, whether it was decided to have a single or a double line. He stated that a double-line bridge might be constructed in this manner, in which unbounded confidence might be placed, for a sum not greatly exceeding that which would be required to reinstate the present structure, so that it might be safely worked as a single-line bridge.

SCIENCE AND ART.

At the banquet given the other evening by the Master and Wardens of the Clothworkers' Company, in their Hall, Mincing Lane, it was announced that the Company had that day voted two thousand pounds to the Technical College of Huddersfield.

School of Practical Fine Art.—The City and Guilds of London Institute have given a grant of £200 to the School of Practical Fine Art, King's College, London, towards fitting the rooms and gallery with art appliances. The proprietors of the *Illustrated London News* have offered this School of Art three drawing prizes of the value of ten guineas each.

The Institution of Civil Engineers.—At the meeting on Tuesday, Mr. W. H. Barlow, F.R.S., president, in the chair, Count Ferdinand de Lesseps, G.C.S.I., was elected an honorary member, in succession to General Morin, deceased, on account of the services rendered to engineering science and practice by the successful prosecution of the Suez Canal works.

London Water Supply.—The Council of the Society of Arts have decided to summon a public Conference to consider the question of supplying London with pure water. The date for the Conference has been fixed for Monday, the 24th inst., and succeeding days. The arrangements for the Conference are now being considered by a committee, and full announcements will be made as early as possible.

London Association of Foremen Engineers.—At the usual monthly sitting held on the 1st inst., under the presidency of Mr. Newton, the Earl of Aberdeen, Sir Francis Wyatt Truscott (Lord Mayor), Mr. Sheriff Woolloton, Mr. Sheriff Bayley, Sir James Clarke Lawrence, Bart., M.P.; Mr. Alderman William Lawrence, M.P., and Mr. Arthur T. Walmisley, C.E., were elected Life Honorary Members. Afterwards Mr. W. Willson Cobbett read a paper, on "A New Woven Driving Band." This was followed by a discussion on belts or bands generally, and which was full of interest to practical engineers and machinists.

Royal Institution of Great Britain.—At the annual meeting of this institution, held on Saturday, Mr. George Busk, F.R.S., treasurer and vice-president, in the chair, the annual report of the committee of visitors for the year 1879, testifying to the continued prosperity and efficient management of the institution, was read and adopted. The real and funded property now amounts to nearly £85,000 entirely derived from the contributions and donations of the members. Forty-nine new members paid their admission fees in 1879. Sixty-seven lectures and 20 Friday evening discourses were delivered in 1879. The books and pamphlets presented in 1879 amounted to about 278 volumes, making, with 509 volumes (including periodicals bound) purchased by the managers, a total of 787 volumes added to the library in the year. Thanks were voted to the president, treasurer, and secretary, to the committees of managers and visitors, and to the professors, for their services to the institution during the past year. The following were unanimously elected as officers for the ensuing year:—President, the Duke of Northumberland, D.C.L., LL.D.; treasurer, Mr. George Busk, F.R.C.S., F.R.S.; secretary, Mr. Warren De La Rue, M.A., D.C.L., F.R.S.

North of England Mining and Mechanical Engineers.—At a meeting of the Institute of Mining and Mechanical Engineers, in the Wood Memorial Hall, Newcastle, on Saturday last, Mr. G. C. Greenwell, the president, in the chair, Mr. William Logan of Langley Moor Colliery, read a paper "On Safety Hooks." The writer showed that although for twenty years safety hooks had been before the public, yet still a great number of deaths take place from overwinding in pits. The statistics from 1855 to 1879 gave the number of deaths at 178, or one life lost for every 23,373,877 tons of mineral raised, and one for every 64,451 persons employed. Mr. H. Hall, Her Majesty's Inspector in Lancashire, states there is one fatal winding accident in every nine and a half millions of windings. For the purpose of preventing the loss of life, destruction of property, and stoppage of work from overwinding, numerous inventions had been brought to the notice of the public; and for the purpose of inviting discussion, the writer described these inventions in detail, and he suggested the appointment of a committee of the Institute for the purpose of completing the investigation.—In the course of the discussion which followed the reading of the paper, several of the members approved of the suggestion, and a vote of thanks was awarded to Mr. Logan for his paper.—Another vote of thanks was awarded to Mr. Thomas Hepple of Urpeth Colliery for a paper read by him on "Cranston's Rock Drill."

MEETINGS FOR THE WEEK.

MONDAY, May 10.

Royal United Service Institution.—8.30 p.m. Sir William Thomson, F.R.S., on Improvements in his Patent Compass.

Royal Geographical Society.—8.30 p.m.

Society of Arts.—8 p.m. Cantor Lecture. Mr. R. W. Edis, on Art Decoration and Furniture in General Domestic Use, Pottery Plate, Gas-fittings, Bronze, Brass and Iron Work.

National Social Science Association.—Dr. Mrs. Garrett-Anderson, on Educational Pressure.

London and Middlesex Archæological Association.—8 p.m.

Institution of Surveyors.—8 p.m.

TUESDAY, May 11.

Royal Colonial Institute.—8 p.m. Professor W. T. Thiselton Dyer, on the Botanical Enterprise of the Empire.

Statistical Society.—7.45 p.m. 1. Captain P. G. Craigie, Ten Years' Statistics of British Agriculture. 2. Mr. J. B. Lawes, F.R.S., and Mr. J. H. Gilbert, F.R.S., on the Home Produce, Imports, Consumption and Price of Wheat over the Harvest Years 1852-3 to 1879-80.

Institution of Civil Engineers.—8 p.m. 1. Major General H. Y. D. Scott, C.B., and Mr. Gilbert R. Redgrave, on the Manufacture and Testing of Portland Cement. 2. Mr. Edwin A. Bernays, on Portland Cement Concrete and Some of its Applications. 3. Mr. John Grant, on Portland Cement, its Nature, Tests and Uses.

Royal Institution.—3 p.m. Mr. R. H. Scott, on Wind and Weather.

Royal Horticultural Society.—1 p.m.

Photographic Society.—8 p.m.

Horological Institute.—8 p.m. Special General Meeting.

WEDNESDAY, May 12.

University of London.—2 p.m. Presentation Day.

Amateur Mechanical Society.—8 p.m. Anniversary.

Graphic Society.—8 p.m.

Society of Telegraph Engineers.—8 p.m. Dr. C. W. Siemens, F.R.S., on the Use of the Dynamo-Electric Current in Horticulture and Metallurgy.

Geological Society.—8 p.m.

Horological Institute.—8 p.m. Mr. W. Chandler Roberts, on Some Applications of the Microphone.

Society of Arts.—8 p.m. Mr. Charles Wood, on the Utilisation and Properties of Blast Furnace Slag.

THURSDAY, May 13.

Royal Institution.—3 p.m. Professor Tyndall, on Light as a Mode of Motion.

Royal Society Club.—6.30 p.m.

Mathematical Society.—8 p.m.

Society for Encouragement of the Fine Arts.—8 p.m. Dr. Phené, on Travels in Asia Minor.

Society of Antiquaries.—8.30 p.m.

Royal Society.—4.30 p.m.

National Health Society.—4 p.m. Dr. S. Wilks, on Overwork and Underwork.

Society of Arts.—8 p.m. Section of Applied Chemistry and Physics. Professor W. G. Adams, F.R.S., on the Optical Properties of Crystals and some of their Practical Applications. Discussion to be opened by Dr. W. Spottiswoode, Pres. R.S.

FRIDAY, May 14.

Royal Institution.—8 p.m. Weekly Meeting. 9 p.m. Lord Reay, on Certain Aspects of Social Democracy in Germany.

Royal Astronomical Society.—8 p.m.

City of London College.—6 p.m. Dr. Heinemann on Political Economy.

Quekett Microscopical Club.—8 p.m.

Royal United Service Institution.—3 p.m. Captain Samuel Long, R.N., on the Tactical Aspect of the Utilisation of Ocean Steamers for War Purposes.

Wharfedale Agricultural Society.—Annual Show. (Two days).

Society of Arts.—8 p.m. Indian Section. M. A. Terrien de la Couperie, on China and the Chinese; their Early History and Future Prospects.

SATURDAY, May 15.

Royal Institution.—3 p.m. Professor H. Morley, on the Dramatists before Shakespeare, from the origin of the English Drama to the year of the death of Marlowe (1593).

RAILWAYS & TRAMWAYS.

THE TAY BRIDGE DISASTER.

THE inquiry into the Tay Bridge disaster was resumed on Thursday last week in Committee-room D, of the House of Lords, before the Wreck Commissioner, Mr. Rothery, assisted by Colonel Yolland, R.E., and Mr. Barlow, C.E.—Sir George Airy was the first witness called, and on being examined by Mr. Trayner, deposed that he was the Astronomer Royal, and resided constantly at Greenwich. He had instruments there which were considered the best to make observations as to the pressure of the wind and its velocity. The heaviest gale he had ever known in this country was that which occurred on the 8th of December, 1872. Its greatest velocity was fifty-seven miles an hour, but its mean velocity was forty miles an hour; the whole distance travelled in the day by the gale having been 918 miles. He recollected the gale on the 2nd of March of the present year, which was continuous, and reached 950 miles in the day. That was the greatest run in the course of a day he had ever known, and the mean rate would be below forty miles an hour. The wind pressure of the gale in 1872 was 50 lb., and that of the gale in 1880 was 30 lb. to the square foot. The gale which foundered the *Eurydice*, on the 24th March, 1878, did not exceed 10 lb. as registered at Greenwich. The records at Greenwich were perfect as to the gale which occurred on the night of the Tay Bridge disaster, and there was no more disturbance than on any common blowing gale. Greenwich was out of the current of the storm, and the pressure registered was 6 lb. He knew the site of the Tay Bridge, and the force of the wind coming down the river there in certain directions would, from the conformation of the land, be greater than in any other place in the country.—(To Mr. Bidder, Q.C.:) The space through which the greatest force of wind operated he believed was limited. The pressure registered at Greenwich he thought was generally exceeded in Scotland, and that which would be 50 lb. at Greenwich might be something betwen 50 and 100 lb. in such a place as at the site of the Tay Bridge. To establish a structure of safety they ought to go higher than 100 lb. An engineer should have provided for 120 lb. If an erected bridge was subjected to a great pressure, it could not recover from it, and it was necessary to make provision for more pressure than would come upon it; but in the case of a suspended pier it was not so, as it could be pushed partly aside, and would return.—(To Mr. Balfour:) A bridge which was suspended was much safer than one which stood upon stilts. After the experience of late years of the force of the wind, he should not trust to the piers of the Forth Bridge without some lateral supports.—(To Mr. Trayner:) It was a very important consideration as to the effect of the force of the wind, whether the girders and portions of the bridge were really continuous.—Professor George Gabriel Stokes (examined by Mr. Traynor) said that he was a Professor of mathematics at Cambridge. Wind was more commonly measured with regard to velocity than as to pressure. The old theory of resistance was almost worthless. It was difficult to measure the velocity of the wind for short periods, and the results of tests must be accepted with some hesitation. There was a difficulty in connecting the velocity of the cups with the velocity of the wind which they were supposed to represent. Dr. Robinson's anemometer was used for measuring the wind, and when the cups of that instrument went at the rate of forty miles an hour it represented a velocity of the wind of 120 miles. The relation between the velocity and the pressure of the wind hydrostatically tried would be a standard pressure of 1 lb per square foot for a velocity of twenty miles; to that would have to be added 80 per cent. according to some and 100 per cent according to other authorities to the pressure of the wind on a plate with the same velocity of the wind. (To the Commissioner): Cyclonic storms occurred in this country very frequently. Mr. Robert Henry Scott, secretary of the council of the Meteorological Office, said (in reply to Mr. Trayner) that there was no anemometer at Dundee, but there were at Glasgow and Aberdeen, from which reports were submitted to the Meteorological Office. The results he had received from Glasgow of the gale on the 28th of December, and the greatest number of miles registered of the speed of the wind in any sixty consecutive minutes was seventy-one miles at Glasgow. The velocity of the gale had also been recorded as follows:—From 6.25 to 6.30 p.m., 96 miles; 6.55 to 7 p.m., 72 miles; 7.15 to 7.18 p.m., 120 miles; 7.30 to 7.35 p.m., 84 miles; 7.45 to 7.50 p.m., 96 miles; and from 8.40 to 8.46 p.m., 110 miles. At Aberdeen between a quarter and twenty minutes past seven, the velocity of the wind was 8 miles, or a rate of 96 miles. Within the last thirteen years the velocity of the wind had repeatedly been 83, 84, and 85 miles within the hour. (To Mr. Bidder, Q.C.:) There was no grounds for believing that the extreme velocity marked by the anemometers were local and partial in their concurrence. The force of the wind in the neighbourhood of London gave no representation of its force in Scotland, where it was much higher. Holyhead was the most stormy place in the United Kingdom from which there were any records. (To Mr. Trayner:) There was evidence to prove that the identical gale of the 28th of December last had at Strontian a force of considerably more than a lateral pressure of 300 feet in width. It unroofed the house of a friend of his (Sir Thomas Liddle), and carried it over a wall, a distance of 100 yards. (To the Commissioner:) It would seem very likely from the direction of the gale on December 28 at Aberdeen and Glasgow that the force of the wind would be about the same at those places as at Dundee.—The Court then adjourned.

At the commencement of the proceedings on Friday, a discussion arose as to the course to be pursued with respect to the order in which the evidence should be taken for the contractors and the railway company, it being understood that the evidence for the Board of Trade was concluded. It was also discussed whether Mr. Trayner should be heard now on the evidence already given, or whether his observations should be deferred till the whole of the evidence was in possession of the Court. It was, however, decided to proceed with the evidence on behalf of the contractors.

Sir Thomas Bouch, in reply to Mr. Bidder, said that he had had great experience in the building of piers and bridges over viaducts. His experience had led him to adopt the form of lattice girders as affording great advantages. He had constructed the Tees Bridge. His rule with reference to the relation between span and girder was to make the depth of the girder one-eighth of the span. He had also constructed the Deepdale and Beela Viaducts. The latter consisted of sixteen spans of 60 feet each, its greatest height being 196 feet. The Tees Bridge consisted of five spans of 120 feet each, and the greatest height above the river was 120 feet. The piers in these cases were built entirely of cast-iron columns of 12 inches diameter, and the thickness of the metal varied from 1¼ inches at the bottom to seven-eighths of an inch at the top. The Redheugh Bridge, which he had also built, consisted of two spans of 280 feet, and two of 240, at a height of 80 feet. The latter was a compound bridge, being half suspension, and the diameter of the columns was three feet. The witness then went into further details as to these structures. The lattice-girder form was that which present, the least surface to the wind, and which, during a period of 20 years, he had found the most advantageous. It was that form he had adopted for the Tay Bridge. With the assistance of Mr. Allan Stewart he had worked out the details of the design with respect to one or two matters; and, in order to be quite clear, he had communicated with Colonel Yolland. He had satisfied himself that the design was sufficient, and, if the foundations had turned out as originally expected, the designs would have been sufficient for their purpose. It was when they reached pier 15 that they found that the foundations were not as represented. The rock disappeared. They adopted the precaution of putting two additional cylinders, and in consequence of this orders were given to bore afresh. The result was that they found a thickness of gravel of about 14 feet where they had expected to find rock. This foundation would not have carried the brick piers, which averaged a downward pressure of six tons per square foot. The question was under his consideration as to whether there should be six or eight columns, on the piers. He himself preferred the six columns, because he could not get the base with eight that he could with six. Hopkins, Gilkes, and Co. were the third from the lowest of the tenders. He was well acquainted with this firm. They had concluded the Deepdale and Beela Viaducts. The difficulty of the foundations led them to make some alterations in the span as well as the columns. The iron piers being much more expensive they were led to increase the length and strength of the span which in a way affected the stability of the building. The ultimate result of these alterations was to place a weight of 2¾ tons per square foot upon the foundations. The 15-inch columns were always intended to have a thickness of 1 inch, and were made that thickness, while the 11 inch columns, which were designed to be 1 inch, were altered to 1¼ inch. The tugs and bolts had been constructed so as to be considerably stronger than the ties, according to the tensions which the cast iron would bear. With regard to inspection steps were taken to secure a thorough and efficient inspection of all parts of the work which proceeded. He never heard any complaints made as to the cast iron. With regard to the suggestion that the malleable iron tie bars, sent from Middlesborough to Wormit, were not tested he was not aware of his own knowledge that any tests were applied. He knew that pieces of iron had been selected at random, and sent to Mr. Kirkcaldy to be tested. He himself carefully inspected the work from time to time. The work was all placed in perfectly good order and was well executed, and inferior work was rejected. He did not believe that there was any foundation for thinking that the holding-down bolts, which held the base plates down, came away from the concrete when they were screwed down. The inspection of General Hutchinson, the Government inspector, was one of the most severe he had ever seen.

Mr. Bidder read extracts from a large number of letters with the view of showing that Noble and Sir Thomas Bouch were in continual communication upon the subject of the bridge. On the 13th of September, 1879, a letter from Noble reported that two of the columns were cracked, and that he had made them secure by putting round them strong iron bands. (Examination by Mr. Bidder continued):—In consequence of that letter witness went and inspected the columns, and found that three of them had been hooped. He was puzzled at the cracks appearing, but as there had been severe frost he thought they occurred through the contraction of the iron. The cracks did not in the least weaken the columns for the purposes which they had to fulfil. The bridge was thoroughly attended up to the date of the accident, and he did not know what more he could have done. After the accident he was called from his bed and went to the bridge by a special train. He had thought a great deal about the accident, and his opinion was that its cause was the capsizing by the wind of the second-class carriage, which took with it the guard's van and came into collision with the girder, the force of the blow being the momentum of the whole train until the couplings broke. His reasons for coming to that conclusion were that the engine and tender were found lying on their side, then some carriages standing erect, and the second-class carriage and guard's van on their side. The broken condition of the second-class carriage and the guard's van, and the fact of the axle-box and horns of the second-class carriage being found in the trough of the girder, where they could only have got when the girder was standing, was conclusive to his mind that they had left the line. The marks on the girder unmistakably showed that. (By Mr. Trayner): The question of the foundation was the only cause for making the piers of iron instead of brickwork; the effect of the change, he thought, was to reduce the vertical pressure from six to three tons. The witness was afterwards examined at some length as to the alteration of the structure, the specification, and the casting of the columns. The columns were designed to bear twenty times the weight expected to be put upon them.

At the sitting on Monday Sir Thomas Bouch's cross-examination was continued by Mr. Trayner on behalf of the Board of Trade. The witness stated that in designing the bridge he made no allowance for wind-pressure. His idea was that the greatest lateral wind-pressure would be 10 lb. per square foot. Not anticipating the loosening of the ties from any cause whatever, he made no provision against its happening. If the ties gave to the extent of a quarter of an inch, the tightening up would bring the column back to its original position. The train went off the line, and the carriages canting over the roofs struck the girder.—(To Mr. Bidder, Q.C.:) If a train ran off the line it did not necessarily leave a mark on the line. The cotters themselves were intended as a provision for tightening up the ties.—The Commissioner before putting any questions to the witness said that the Court felt for him under the circumstances, and would endeavour not in any way to distress him; but Sir Thomas would quite understand that it was their duty to ascertain the cause of the casualty, and no one had a greater interest in that result than himself. The witness, in reply to the Commissioner, said that the computed weight of brick piers and the superstructure, according to the original design, but not carried out, was 1962 tons upon an area of 52 superficial feet. The superficial area of the caisson afterwards sunk was 750 square feet. It was intended to line the caissons with brickwork, and fill it up with concrete to raise the brickwork above high-water mark. The original design provided for eight columns, all of 1 inch thickness, and when the alteration was decided on he intended to continue the eight columns. It was his impression that he had had the bolts and lugs adjusted so as to considerably strengthen the ties. The bolt-holes ought to have had sides perfectly square and parallel, and had he known they were not so he would have had them rymed. The result of the defect would be that the bolts would give until they got a bearing on the sides of the hole. The strains on the ties would be very little, except from the wind, even when a train was going over the bridge, for the whole of the strain would be upon the columns. The ties were not to keep the columns in position. The crack in the column was in a place where there was a great strain. The cement would expand in the act of setting, and that would bring a strain upon the iron, but not sufficient to crack it. He never found it necessary to allow for the escape of the moisture in the cement. The cause of the accident, he believed, was the collision of a portion of the train with the girders. The simple cutting through of two of the girders would be sufficient to bring the structure down. The Commissioner: The bridge was so constructed that if one or two of those ties in the girders gave way the whole of the bridge between the high girders would come down?—I think so; the girders going, the piers would come down one after another. (To Mr. Barlow, C.E.): He did not know the reason of the change from angle-iron to flat bars. The reason of the alteration of the bolts from the specified size of 1¼ to 1⅛ inch was not within his recollection. The connecting of the L girders at the top of the piers would have given an extra stiffness, but he did not think it was required.—Charles Meek (examined by Mr. Barlow, Q.C.) deposed that he went to Dundee last month and surveyed and took dimensions of the girder recently raised. That showed that several of the struts and ties had been broken by something that impinged upon them. He found splinters of wood in the lattice works and a rivet struck out.—William Thoms, diver, was the next witness examined. In reply to Mr. Bidder, Q.C., he stated that he had been under water to where the second-class carriage was found. One of the wheels was in the lattice-work, and the southern pair of wheels were gone. The carriage stood alone. (To the Commissioner:) The north end of the second-class was canted a little to the east, and the south end a little to the west. Henry Dewey (another diver) stated in reply to Mr. Bidder, Q.C., that he assisted in raising the girders, first going down under the water on April 5. He found the couplings between the van and the second-class carriage were disconnected. (To Mr. Trayner): The water was quite dark, and he could not see, but had to feel his way. (To the Commissioner): The van partially rested upon the carriage and was partially embedded in the ground, so that the carriage was lifted from under the van. —John Holsworth Thomas, in answer to Mr. Bidder, Q.C., said that he was a diver of some experience, and had been employed in raising the *Eurydice* and other ships. He was in charge when the dynamite was used at the Tay Bridge. The attempt to raise the girder with the carriage in it was a failure, because it had not been separated from another part of the wreck. A part of the rails and of the east boom was not severed as it should have been. After trying unsuccessfully to lift the girder as a whole, it was cut sectionally from one pier to the other to be raised. He found one of the missing wheels of the second-class carriage about forty-five feet south of the pier. (To Mr. Trayner): They were trying for twenty-four hours with two pontoons with powerful machinery, and aided by steamers, to raise the girder but could not do so, and some part of the structure was broken in the attempt. Dynamite was then used to separate one part of the girder from the other.

On Tuesday, Mr. Bidder, Q.C., before calling witnesses, desired to make a statement. Some one had written to the Board of Trade, drawing attention to what the writer thought was material to the case before the court—namely, that Sir Thomas Bouch was a shareholder in the firm of Messrs. Hopkins, Gilkes and Co. It was only right, therefore, that it should be stated that at the time the contract with Messrs. Hopkins, Gilkes, and Co., was entered into, in 1874, Sir Thomas Bouch had not the slightest connection with the firm, nor had he ever had any connection with it previously. Sir Thomas had a brother who was a shareholder in Hopkins, Gilkes and Co., but his brother two years afterwards—in 1876—died; and Sir Thomas, under his brother's will, being left the sole executor, the shares of his brother devolved upon him. He found that his brother—who had been a director of the company—had made himself generally with four other directors liable to the bankers for £100,000. Sir Thomas Bouch found it impossible to get rid of his shares, and also that he had to pay £13,000 in calls upon them. It would only be fair to Sir Thomas Bouch that he should have an opportunity of corroborating that statement.—The Commissioner said that the Court also considered it only just to Sir Thomas Bouch that the statement having been made to the Board of Trade he should be allowed to corroborate Mr. Bidder.—Mr. Trayner stated that the Board of Trade having received the communication he had felt bound to make inquiries; but the result was to negative any suggestion that there was any interested motive on the part of Sir Thomas Bouch in the contract with Hopkins, Gilkes and Co. He (Mr. Trayner had therefore refrained from putting any questions to Sir Thomas on the subject.—Sir Thomas Bouch was then recalled, and in reply to Mr. Bidder and the Commissioner, stated that upon the death of his brother he found that £35,000 was invested in the undertaking of Hopkins and Co.; that he was liable for £13,000 more in calls; and that he had also, with other directors, made himself liable to the bankers for £100,000, which they had advanced.—James

Waddel and John Robinson were then shortly examined as to the recovery of portions of the wreck of the bridge, and lifting the girders, the latter also stating that he had on several occasions observed the trains get off the rails. The tendency of that would be to tear up the rails. A guard rail would be some protection.—Sir Thomas Napier Armitt, in reply to Mr. Bidder, Q.C., said that he was engaged in raising the wreck of the bridge. All the operations were carried on under his supervision, and he lifted 1600 feet of girder, together with the engine and wrecked train. The girder at the north end was in all its parts more complete than the one at the the south end. (To Mr. Trayner.) He had never in his experience known wood when coming into violent collision with iron to smash the latter. When he raised the fragments of No. 4 girder he formed the opinion that the carriages had gone off the line. and that view had since grown upon him. (To Colonel Yolland:) He did not think the engine left the line.—Hugo Drummond, examined by Mr. Trayner said that he was the locomotive superintendent of the North British Railway Company. Wtness produced some sketches showing the carriages of which the train was composed, and also a report which he had on the 15th of April made with reference to the catastrophe. The second-class carriage was (he said) the only one of light construction. He found nothing on the tires or axles which suggested to his mind that the carriage had left the rails. None of the carriages had left the rails until the girders had left their places on the pillars. (To Mr. Bidder, Q.C.: That was an opinion formed after examining the carriages, and before hearing any of the evidence given in the Court. The side of the carriage would be destroyed if it came into collision in a state of high velocity with the girders. The greater the velocity of the train the less the effect on the iron. The whole of the axles which were found were bent. The carriages, he believed, did not leave the rails before they reached the water. He never knew of a train with either heavy or light carriages being blown off the rails by the wind. The Westinghouse brake, which was under the control of the driver, was used in the train. Witness could not tell whether or not the brake had been applied.—The Commissioner desired to know if there were any witnesses who could give any information as to the state of the girders before the use of dynamite. The Court had allowed the use of dynamite on the condition that such information was forthcoming. —Mr. Balfour said that there were no witnesses to be brought on that question, but the dynamite had been used on a very limited area, which had been pointed out.—Dr. William Pole, C.E., F.R.S. (examined by Mr. Bidder, Q.C.), deposed that he had had great experience in the construction of bridges, and had made the subject of the behaviour of cast and wrought iron his study for many years. In January he was invited by Sir Thomas Bouch to investigate the circumstances attending the Tay Bridge disaster, but previously had had nothing to do with that structure. He went to Dundee for the purpose of the investigation, and the result was embodied in a letter to Sir Thomas Bouch, dated the 25th of February, which had been put before the Court. The calculations were made independently of any previously made by Sir Thomas Bouch. The two main elements of consideration were the girders and the piers. He (witness) considered their strength both with regard to the loading of the bridge and the pressure of the wind.—The Commissioner said that it might shorten the evidence if he expressed the opinion of the Court that, so far as the strength of the girders were concerned, there was no doubt whatever that they were sufficiently strong for their purpose. No doubt had been thrown upon that by any portion of the evidence.—The witness continued that the girders he found were amply strong for any strain that might be required either as to loading or as to the wind. The girders were admirably designed. He could not understand how any wind could have blown them off the piers.—The witness was under examination when the Court rose.

On the resumption of the inqury on Wednesday, Dr. Poole's examination (by Mr. Bidder, Q.C.) was proceeded with, and the witness stated that the result of his investigation as to the piers was that they had to bear the weight of the girders and the moving load of the trains. The crushing weight which would come upon them would be only $\frac{1}{18}$th of that which they would bear. Bracing was adopted as a precaution rather than as necessary to bear any strain. There was a slight tendency in high columns to bend; but under ordinary circumstances the strain upon the bracing would be very slight indeed. His attention had frequently been drawn to the subject of wind pressure, and on that subject the first information obtained by engineers was in a paper read before the Royal Society by Smeaton in 1759, which contained a table of the velocity and force of winds. That table enumerated the force per square foot which the wind might exercise. A high wind, he said, would exercise a force of 4·4 to 6 lb. per square foot; a very high wind, 7·8 to 10 lb.; and a storm or tempest, 12·3 lb., which was equivalent to a velocity of 50 miles per hour. Mr. Smeaton also gave a table which was treated as authoritative, and referred to by all sorts of engineering books, and it furnished to engineering notebooks the only authority for judging of the force of wind. That table gave the force of a great stom as 17·7 lb. per square foot of a hurricane as 31·49 lb., and of a hurricane which tore up trees or carried buildings before it as 49·2 lb. per square foot. Violent storms (the witness said) were extremely local. When the Forth Bridge was proposed the question of the wind-pressure was seriously considered, and the only reason for adopting a different figure in the case of the Tay Bridge would be that because of the smaller dimensions it would be more subject probably to the action of gusts of winds. Twenty pounds per square foot would be ample for the purpose of providing for the pressure. In his calculations he had taken no credit for the bearing power of the concrete in the columns. 20 lb. of wind pressure allowed for a large margin. No force of wind could have been expected to have come upon the bridge so as to have broken the ties. No statical force could have brought down the bridge. There must have been something in the nature of a shock to have caused the disaster, and he was confirmed in that view by the fact that in all cases the ties had broken by the rupture of the cast iron, and by no fracture of the ties themselves. Cast iron gave way most readily under shocks. Under a wind-pressure a carriage must turn over long before there was any danger to the bridge. If the carriages got off the rails there must have been a force expended in addition to the force of the wind which was sufficient to account for the shock, which was the element wanting to explain the universal fracture of the cast-iron, and to account for a shock which would have brought down the bridge. No statical pressure on the bridge could upset it. A statical pressure of 33 lb. per square foot would upset the carriages; and such a pressure would not upset the bridge. Indications of the way in which portions of the bridge gave way led him to infer that a shock was the cause of the disaster. If the two last carriages did leave the rails, and come into collision with the leeward girder, that was a sufficient cause to produce a shock adequate to account for what happened.—(To Mr. Trayner): He had designed several bridges, but there were no bridges in this country which had been erected from his designs. He did not remember that any one since Smeaton's time had recommended a resisting power of more than 20 lb. to the square foot. Professor Rankine might have recommended 50 lb., but he was travelling out of his province. The lowest diagonal tie was the one which would have had to bear the greatest strain, and would therefore give way first. It was necessary to provide for a greater lateral pressure in the Tay than in the Forth Bridge, because of the smaller extent of the structure of the Tay. It was easier to design a stable bridge for the Forth because it was broader, but designs were prepared to meet wind-pressure whether the bridges had one or two lines of rails. If two carriages struck against the contiguous lattice girders it would be sufficient to upset the bridge. He rather doubted whether a second-class carriage would have sufficient strength to knock out the ties and struts by a collision. If it went against the ties and struts at a high velocity the carriage would have been broken, but it would have told its tale on the iron. (To Mr. Bidder, Q.C.:) He did not think that the piers gave way first, but that it was the girders that had given. Any lateral pressure or blow on the girder must ultimately be transmitted undiminished to the lowest part of the pier. (To the Commissioner:) The marks on the girders indicated a very severe shock to the bridge. The bolt holes should have been square. The bolts would be likely to bend until they got a bearing on the conical side. It was possible that the bolt holes were conical. All the piers had gone at the base. That he expected, because when the ties had gone the columns must turn upon their bases, for there was then nothing to prevent each column turning over. The pier did not go as an entire structure.—Mr. Webster, calling attention to the witness's remarks as to the bolt holes, said that the suggestion that the conical boring of the holes enabled the column to slide bodily over had never been made by any witness.—The Commissioner and Mr. Barlow expressed the opinion that the suggestion had been made to the court.—The witness (to the Commissioner) continued that he had never turned his attention specially to the subject of wind pressure, If the L girders were connected at the top of the piers their stiffness would have been greater. There would have been no difficulty in connecting them; but he did not see that it was necessary. The narrowness of the piers had not contributed to the catastrophe, and it would not have added to the strength of the pier to have had two columns outside instead of one. If the lower part of the 18-inch column had broken the bridge would have come down. A second column at the side would in that case have added strength.—(To Mr. Barlow:) Had there been two outer columns and one had broken the other might have saved the pier from coming down. The columns without braces would not stand. There was no evidence, he thought, that the piers had gone for want of width.

NAVAL ARCHITECTURE.

THE *Calais-Douvres* commenced her regular service between Calais and Dover on Tuesday.

EXHIBITION OF NAVAL AND MARINE ENGINEERING MODELS.—A large and influential committee of shipbuilders and marine engineers has been formed in Glasgow for the purpose of promoting an exhibition of naval and marine engineering models in Glasgow. It is proposed that the Exhibition shall be opened in the Corporation Galleries in November, and remain open for six months. Mr. James Paton, the superintendent of the Glasgow Museum and Galleries, has been appointed secretary to the committee.

DISASTERS AT SEA.—There were 25 British and foreign wrecks reported during the past week, making a total of 544 for the present year, or a decrease of 81 as compared with the corresponding period of last year. The approximate value of property lost was £535,000, including British, £425,000. The *Bureau Veritas* has just published the following statistics of maritime disasters, reported during the month of March, 1880, concerning all flags:—Sailing vessels reported lost—42 English, 14 American, 12 Norwegian, 10 German, 7 French, 5 Dutch, 3 Danish, 3 Italian, 3 Portuguese, 2 Spanish, 1 Austrian, 1 Swedish, 1 Turkish, 3 of which the nationality is unknown—total, 107. In this number are included 14 vessels reported missing. Steamers reported lost—9 English, 2 French; total, 11. In this number are included 1 steamer reported missing.

HER MAJESTY'S SHIP "BACCHANTE."—The *Bacchante*, with the young Pinces Edward and George of Wales, arrived at Spithead in the beginning of the week, and saluted the flag of Admiral Ryder, the Commander-in-Chief, at the termination of their first cruise at sea. The cruise, which has extended over nearly eight months, has proved in every respect a gratifying success; and though like the Queen, the Prince of Wales only intended his second son to become a sailor—the constitutional position of Prince Edward as the eldest son of the Heir Apparent preventing his adoption of the Navy as a profession—the selection of the service as a "practical training school" for both boys has given great satisfaction to the Navy. With the exception of not keeping night watch and not being sent out in charge of boats, the Princes have been throughout the cruise performing the ordinary duty of midshipmen, and have messed in the gunroom

CONTENTS.

		PAGE
IRON AND STEEL INSTITUTE ...		325
BATEMAN'S BOILER FITTINGS...	(Illust.)	329
BRASS-FINISHERS' LATHE ...	(Illust.)	329
UTILISATION OF TINNED-IRON WASTE ...		330
SLAG CEMENT ...		330
OUR TRADE SUMMARY ...		330
OCCASIONAL NOTES ...		330
SCIENCE AND ART ...		333
RAILWAYS ...		334
NAVAL ARCHITECTURE ...		335
NOTICES OF BOOKS ...		335
FACTORY NOTES ...		336
IRON AND COAL TRADE REPORTS ...		336
CONTINENTAL MINING AND METALLURGY ...		338
NEW PATENTS ...		339
COMMERCIAL ...		339
THE IRON TRADE OF THE CONTINENT IN 1879 ...		341

OFFICIAL NOTICE.

ALL payments for Subscriptions, Advertisements and General Accounts are to be remitted to the **Office, 161, Fleet Street, E.C., London,** Cheques and Post Office Orders to be made payable to PERRY F. NURSEY, and crossed "London and County Bank."

Advertisements and other Business Communications to be addressed to the PUBLISHER.

To ensure insertion, Advertisements should reach the Publisher not later than Thursday morning.

Communications on literary subjects and books for review are to be forwarded to the EDITOR. Anonymous correspondence will be wholly disregarded, and the return of rejected MSS. cannot be guaranteed.

All Subscriptions are Payable in Advance, at the ollowing rates per annum, **including postage**:—

	£	s.	d.
The United Kingdom..	£1	8	6
British Colonies generally and United States	1	10	0
India, China and Japan	1	15	0
South America, East Coast	1	10	0
,, ,, West Coast	1	15	0
The Continent of Europe, Egypt and Algeria	1	10	0

Further information will be supplied on application to the PUBLISHER, 161, Fleet Street, London.

FRANCE.

MESSRS. GALIGNANI (Baudry, Jeancourt et Cie.) of 224, Rue de Rivoli, Paris, will supply thick or thin copies of IRON on application, and will receive subscriptions or advertisements.

THE UNITED STATES.

Messrs. WILLMER and ROGERS, Beekman Street, New York, will supply thick or thin paper copies of IRON on application.

NOTICES OF BOOKS.

Bristol, Past and Present. Bristol: J. W. AINSWORTH. A HISTORY of this, one of the most ancient and important of the great towns of England is now being published in parts. It will be complete in three volumes, the first two being devoted to the civil and ecclesiastical history of the city and issued together. The subject of the third will be Modern Bristol. Judging from the first instalment the work seems likely to prove a valuable addition to the long list of local histories. It is beautifully illustrated with very effective wood engravings, and the paper and printing are both of a high class.

BOOKS RECEIVED.

A Description of the Differential Expansive Pumping Engine. By Henry Davey, M.I.C.E. London: E. and F. N. Spon.

Brazil: The Amazons and the Coast. By H. H. Smith. London: Sampson Low and Co.

Bristol, Past and Present. Part I. By J. F. Nicholls, F.S.A., and John Taylor. London: Griffith and Farren; Bristol: Arrowsmith.

Gas Works Statistics, 1880. Edited by C. W. Hastings. London: C. W. Hastings.

On the Regulation of Production. By R. S. Moffat. London: Tinsley and Co.

Pocket Mining Atlas. By Edwin Bolitho. New York: *Engineering and Mining Journal* Office.

Practical Boat-Building for Amateurs. By A. Nelson, C.E. London: The "Bazaar" Office.

Principles of Agriculture. By Albert Carey. London: Murby.

The Gas and Water Companies' Directory, 1880. Edited by C. W. Hastings. London: C. W. Hastings.

The Great Artists:—Horace Vernet, Paul Delaroche. London: Sampson Low and Co.

The Water Supply of the Metropolis and the Proposed Transfer of the London Water Companies to a Public Authority. By J. Quick, M.I.C.E. London: E. and F. N. Spon.

Winding and Unwinding in Collieries. By C. M. Percy. Third edition. Wigan: *Observer* Office.

NEW BOOKS.

A Course of Qualitative Chemical Analysis. By W. G. Valentin. 5th edition. 8vo. Churchill.

Annual Register (The) of the Year 1880. 8vo. Rivingtons.

Applications (The) of Physical Forces. By A. Guillemin. New edition. 8vo. Macmillan and Co.

Academy Notes 1880. (No. 6). Edited by H. Blackburn. 8vo. Chatto.

- Celestial Scenery: or the Wonders of the Planetary System Displayed. By T. Dick. 12th edition. 8vo. Griffin and Co.
- Destruction of Life by Snakes, &c., in Western India. 12mo. W. H. Allen and Co.
- Evolution and Involution. By G. Thompson. 8vo. Trubner and Co.
- Elements of Pharmacy. By G, S. V. Wills. 3rd edition. 8vo. Simpkin and Co.
- Epidemiology: the Remote Cause of Epidemic Diseases. By J. Parkin. Part 2. 2nd edition. 8vo. Bogue.
- First Lessons in Theoretical Mechanism. By J. F. Twisden. 2nd edition. 8vo. Longmans and Co.
- Great Artists (The):—Michael Angelo). By C. Clement. 8vo. Low and Co.
- Grosvenor Notes, 1880. (No. 3). Edited by Henry Blackburn. 8vo. Chatto.
- Heat, a Mode of Motion. By John Tyndall. 6th edition. 8vo. Longmans and Co.
- Hemicycle (The) of the Palais des Beaux Arts, Paris. By Paul Delaroche. 8vo. Low and Co.
- In Search of Minerals. By D. T. Ansted. 8vo. S.P.C.K. (Natural History Rambles).
- Ponds and Ditches. By M. C. Cooke. 8vo. S.A.C.K. (Natural History Rambles).
- Recent Depression (The) of Trade. By W. E. Smith. 8vo. Trubner and Co.
- Scientific Structure (The) of the Universe. By G. A. Moncrieff. 8vo. M. Ward and Co.
- Six Lectures on Physical Geography. By Rev. S. Haughton. 8vo. Longmans and Co.
- Water Supply. By J. H. Balfour Browne. 8vo. Macmillan and Co.

FACTORY NOTES.

REMOVAL.—Mr. J. J. Bodmer, mechanical engineer and inspector of railway material, has removed his offices from Blomfield Street to Dashwood House, New Broad Street, E.C.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending 1st May:—On Monday, Tuesday and Saturday (free), from 10 a.m. to 10 p.m., Museum, 12,583 Mercantile Marine, Building Materials, and other Collections, 2297. On Wednesday, Thursday and Friday (admission 6d.) from 10 a.m. till 6 p.m., Museum, 2422; Mercantile Marine, Building Materials, and other Collections, 131; Total, 17,433. Average of corresponding week in former years, 16,546. Total from the opening of the Museum, 18,898,713.

WATERPROOFING LEATHER.—A new method of waterproofing leather has been successfully adopted by Messrs. S. E. Norris and Co., of Shadwell, the well-known makers of leather-belting, &c. This method, which seems to be capable of many valuable applications, so acts upon the leather as to hinder its absorbing more than 6½ per cent. of its weight of water after an immersion of five hours, while leather not treated absorbs 25 per cent. of its weight in the same time. The waterproofed leather is evidently well adapted for the manufacture of leather buckets, leather for colliery pump purposes, &c., the fibres being arrested. Buckets made or blocked from leather so treated, last, it is said, twice as long as those made from the ordinary sort.

SOUTH LANCASHIRE AND CHESHIRE COAL OWNERS ASSOCIATION.—The ordinary meeting of the members of the above association was held on Tuesday at the Queen's Hotel, Manchester, Mr. Pilkington, the president, in the chair. The chief matter under consideration was the necessity of improved railway and dock accommodation for the shipment of coal from Liverpool, and it was stated that since the last meeting of the association there had been several conferences with the railway companies, and deputations had waited upon the Liverpool Dock Board, the London and North-Western, the Lancashire and Yorkshire and the Sheffield and Lincolnshire Railway Companies with the view of obtaining that increased accommodation it was felt the requirements of the trade demanded. Several members of the association had also visited the Grimsby Docks, where they were very cordially received, and every facility afforded for inspecting the arrangements there made. A strong feeling was expressed that the increased accommodation which the Lancashire coal trade demanded ought to be obtained, and it was resolved that the association should continue to press upon the Liverpool Dock Board and the several railway companies the importance of providing further facilities for the shipping trade in connection with the Lancashire collieries, and that the coal trade generally throughout the district soould be asked to assist the association in the efforts it was making.

SOUTH LONDON TRAMWAYS COMPANY.—According to the prospectus of the Company, the tramways authorised to be constructed under the Special Act incorporating it, will, with the extensions for which application is being made in the present session, form a system about eight miles in length (part of which is a double line), passing through one of the most populous, active, and increasing districts in London, and will, in addition, serve an enormous population on all sides of the district. The line already authorised commences at Plough Lane, Battersea. Passing Belmont (the extensive works of Price's Patent Candle Company), it is continued along the York and Battersea Park Roads, by Battersea Park and the two Stations of the London, Brighton and South Coast, and London, Chatham and Dover Railways in those roads, and thence to a point near the Steamboat Pier, Nine Elms. The population is of a class requiring tramway accommodation, and is increasing at a greater rate than any other metropolitan district. The project of establishing these tramways has met with warm support from the local authorities and the public. The extensions being applied for in the present session received the sanction of the Metropolitan and Local Boards of Works, and the Bill has passed all stages of the House of Commons without opposition, and stands for the formal third reading at the sitting of the House. By means of this system of tramways the whole district is put into direct communication with no less than seven important railway stations. Clapham Junction (where over 850 passenger trains arrive and depart every day), Wandsworth, Battersea, York Road, Battersea Park Road, Queen's Road, and Wandsworth Road. These stations belong to different railways communicating with the Termini at Waterloo, London Bridge, Cannon Street, Ludgate Hill, Victoria and the Crystal Palace, and in fact with every railway system in London, north and south of the Thames. The lines will be laid with steel rails and granite setts, firmly embedded on a thick layer of concrete, and in the most durable manner, so that the large outlays for renewal rendered necessary in the earlier tramways will be avoided. The authorised capital of the Company is £70,000, and subscriptions are now invited for the first issue of 5000 of £10 each. The surplus of this issue of £50,000, beyond the amount required for the present lines, will be applied to the extensions, and the unissued capital, £20,000, will be applied to the same purpose, and such shares will be offered in the first instance at *par* to the allottees of this issue.

IRON AND COAL TRADE REPORTS.

BARNSLEY AND SOUTH YORKSHIRE.—Business in connection with the finished-iron trade throughout this district is not so active as it was a short time ago, yet some of the works seem to be fairly off for orders placed early in the year. Those at Milton and Elsecar are doing a steady business, whilst at Thorncliffe, where a good deal of gas apparatus is constantly produced the men have no cause to complain. The foundries are engaged for the most part with repairs connected with collieries and similar works. The production of pig-iron does not vary a great deal, the decline in price having made no visible alteration to the make. The chief supplies of iron ore used in the district are being obtained from Lincolnshire, but some little is being got at Thorncliffe, Church Lane, and in the neighbourhood of Hazelhead. There is very little to note respecting the coal trade, and although the district possesses some of the finest collieries in the United Kingdom and two exeellent seams of coal, the pits are not working on the average more than four days per week. It is true there are exceptions to the rule, but these are comparatively few, and occur at collieries where large contracts are on hand. The house-coal trade, so far as it relates to the Barnsley and Silkstone seams, is in a very quiet and unprofitable condition. The London trade shows very little, if any, change for the better, the coalowners being virtually outside the market. Local sales are very moderate, and the same may be said with regard to Lincolnshire and the eastern counties. The steam-coal trade is rather brisker, a fair tonnage being sent to both Hull and Grimsby for shipment. The question of the prices at which hard and locomotive coal shall be supplied by contract occupied the attention of an important meeting of the members of the South Yorkshire Steam Coalowners' Association, which was held at the King's Head Hotel on Tuesday. The meeting, which was called by circular, had reference to a pending contract for 40,000 tons of steam-coal for Russia, the extension of a Hull contract, and that for the supply of locomotive coal for the Midland Railway Company, whose contract, together with those of the Great Eastern, and Manchester, Sheffield and Linconshire Railway Companies, expire at the close of the present month. When the contracts were last fixed the prices were remarkably low, in fact, so moderate were the rates that some of the pits in the district were almost closed rather than accept them. As is usually the case, certain prices were fixed, and although it is said they have been departed from in past years, it is understood they are this time to be binding. There is no change to note with respect to the demand for small coal and slack for engine purposes, supplies of late having been regulated by the quantity used for coke-making purposes. Coke, although lower in price, is still in fair request, but the rapid increase in the output seems likely to soon exceed the demand. The greatest possible activity has of late been apparent with regard to the erection of new ovens in all parts of the district. At Thorncliffe, a number of new ones, fitted with a patent obtained by Mr. Chambers, one of the owners, are being built, whilst several of the old ones have been adapted to the new invention. Workmen belonging to the firm of Messrs. Newton, Chambers and Co. have also been in Wales and Derbyshire, attaching the patent to existing ovens there, it being said to work admirably. The district is still much exercised with respect to the projected Hull and Barnsley Railway. Petitions in support of the new line are being numerously signed by the mining population, and arrangements are being made for holding a demonstration at Barnsley in favour of the scheme, aided by the Old South Yorkshire Miners' Association. The Barnsley Town Council on Tuesday also resolved that petitions duly signed and sealed should be presented to both Houses of Parliament in support of the new scheme, which the resolution states is "one calculated to promote the future welfare of the town and to stimulate the development of the vast coal and mineral district of South Yorkshire, of which Barnsley is the reputed centre."

BARROW-IN-FURNESS AND NORTH LANCASHIRE.—There is a very quiet demand for all descriptions of hematite pig-iron, and the request during the last two months, has shown as rapid a decline as was the advance in value, and the increase in demand in the closing mouths of last year. Buyers have but few wants, and the large deliveries of iron yet to be made on account of contracts held by makers in various parts of the district are likely to be sufficient to meet the requirements of the market for some months to come. In the very great demand which existed during the months from September in last year to February in this year, there was undoubtedly a very great amount of speculative business, and huge parcels of iron began to congregate in the hands of second-hand buyers. With the decline in demand and in values, holders of iron in these instances were glad to sell at any price which would secure to them the best terms, and as a consequence the market soon became glutted. This is the position at the present. Buyers have bought well forward and makers are sold well in advance. For the moment therefore there is only a small amount of new business being done, but at the same time there is the greatest industrial activity both at iron and steel works, and also at the shipbuilding and engineering establishments which are included in the leading works of the district. Iron is practically unquotable, but nominally, Bessemer stands at about £4, and forge qualities at about £3 15s. to £3 18s. per ton at makers' works. There is no question that values have a further tendency downward. Iron ore, which is in large outpnt and in considerable demand by local smelters, is lower in value, and samples can now be bought at under £1 per ton at the mines. There is no new feature to note in the steady position of the coal and coke trades. Shipping is briskly employed.

BIRMINGHAM.—Business in the leading local hardware branches of industry is still reported, with few exceptions, as being far from satisfactory. What little animation has been experienced is chiefly due to export demand, and this is limited to a few markets, and to certain special manufactures. Taking a broad line of classification, iron hardwares may be said to be in a somewhat worse position than brass and copper goods. Although even the latter are generally reported just at present as in very slack demand. Still some of the principal firms in this department have done very well this year on the whole, fancy articles in the old English styles having been the leading articles. Common goods being in much less request. For both iron and other hardwares the slightly-improved export trade is chiefly attritutable to orders from Mexico and Central America, generally Brazil, the River Plate, and other South American markets, Cuba, and the West Indies. From our Australian Colonies and New Zealand there is as yet little improvement in the indents, owing to the activity of American competition which has admittedly been attended with considerable success. Hinge-makers have been doing a fair trade, however, with some Colonial firms, and with the South American States, but prices have been at a very low standard, in the face of keen competition. The home trade is much depressed, and retailers report that stocks do not move off at all freely. Another factor which contributes to keep trade very dull is the scarcity of money and the unwillingness of manufacturers and factors to extend customers the credit which has already been stretched to an enormous limit. A few of the best chandelier houses have been fairly busy on good work under special contracts, but the general trade in the chandelier and gasfitting branches is altogether inanimate. Such orders as have been booked have been chiefly for Stannate goods for export and early English bright brass patterns for the home market. The stove-grate trade is quiet, with a tendency to improvement for the best classes of goods. For gas-stoves, too, there is but little demand. Gas-engines are in growing request for employment in light manufacturing operations. Galvanising firms report a decreased demand, although prices are somewhat easier, and tube manufacturers, notwithstanding reductions made in favour of buyers, are far from busy. In the cut-nail trade, too, the recent drop of 10s. per ton seems to have no effect whatever in stimulating activity. Manufacturers of gas apparatus are pretty full of work, one of the leading local firms having gasholders on hand for Sheffield, Leamington, Bristol, Oldbury and other places, as well as several contracts for purifiers and condensers in various parts of the country. The local iron trade is still in a drooping and unsettled state, owing to the falling-off in the American demand, and the absence of activity in home consumption. The depression is chiefly felt by manufacturers of unmarked iron, whose mills and forges are now not working full time, and the want of orders is a subject of very general complaint. Prices have, of course, fallen, partly in consequence of sales pressed by middlemen, and partly from the action of smaller makers, who are sadly in want of orders. Quotations for unmarked bars and sheets are fully 25s. to 30s. per ton under those current at the opening of the year. Melting pig is in fair request for foundry purposes. On 'Change at Wolverhampton on Wednesday the market showed some slight improvement in tone, quotations being just a shade stronger, and the aggregate of iron turned out in the district being reported somewhat in excess of the previous week. The delivery of coal at the Hamstead sinkings was the subject of considerable congratulations on 'Change.

THURSDAY EVENING.—On 'Change to-day business was still inactive, and there was very general complaints of scarcity of orders. Prices, however, were tolerably firm, the strike in the iron trade in the north-country tending to strengthen it. Pig-iron in very limited demand, but some fair prices in hoops, tube, wire, rod, strip and nail-making iron. No change in week's quotation, either as to iron or iron making. Supply of house coal in excess of demand, and prices weaker.

CARDIFF.—The prosperity of the iron trade in this district is more a thing of past transactions than present dealings. The quantities turned out from the several works continue undiminished, and will do so for two, three, or more months to come, even were no fresh orders to be booked; but it is doubtless with some anxiety that the suspension of new business is perceived to be the ruling feature of the hour. How soon it will give place to healthy and active enquiry all are desirous of descrying in the near future, but none can speak with positive knowledge. Meantime, prices of ore and ore freights are lower in sympathy. The inferior foreign minerals which were exploited when the Bilboa produce ran up to fancy figures are certain now to be left to their merited obscurity. Their importation into South Wales did not improve the quality of the manufacture. But now the best Spanish can be obtained at reasonable rates, while Barrow ore is again more largely sought after, and the result will be higher quality than ever. The tinplate works are doing as largely, but no remuneratively, as recently. There seems to be no fear of this manufacture maintaining its ground: and tin standards have been raised in Cornwall. At the trial of the West of England Bank Directors, which has resulted in the acquittal of the defendants, it was stated by the liquidator that the works of Messrs. T. and W. Booker and Co. made a profit of £10,000 in the first quarter of this year. It is difficult of comprehension how, if this was the case, the same works should not have reduced their indebtedness to the bank in the years 1871—4. To outsiders it will appear the criminality lay in the manner in which the bank was hoodwinked and victimised, although nothing can condone the launching of that company as a promising investment upon an ignorant confiding public. In the coal trade there continues to be a large business doing, with a tendency to diminution of daily output in the collieries which are kept at full work, and full work is the rule. It is a singular instance of the immobility of the labouring population that the colliers in the Forest of Dean, who are distressed through the stoppage of the Park End pits, should not find their way to employment in South Wales. They remain starving, on the expectation, well or ill founded, that the works may resume. It is only the best men, who are the wealth of any country, who have energy and sense enough to shift quarters promptly, and such do so at the present time to America, in numbers that are rather disquieting. Ocean-going steamers are taking large quantities of Welsh coal at Liverpool, and when the contractor is behindhand competitors who turn their waggons into a wharf, are ready to accommodate anybody going short. Freights to the Black Sea and to the Eastern ports of the Mediterranean are ruling high for lack of good home employment. Coasting freights are easier.

CLEVELAND.—The pig-iron market was firmer on Tuesday, and there were more buyers. The market opened at 39s. 6d. and closed at 40s. The ironmasters' returns for last month just issued are considered highly favourable. There has benn a very slight decrease in the make as compared with that of the preceding month, but the stocks have been reduced to the extent of 14,000 tons. The shipments of foreign pig-iron from the port of Middlesborough during the month of April have increased by 22,500 tons over those of the corresponding month last year, and the shipments coastwise by 260 tons. Only one-third of the foreign shipments, it seems, have gone to America, so that we need not be so much alarmed if these should fall off. In the finished-iron trade the topic of chief interest is the strike consequent upon Mr. Waterhouse's finding. The sliding-scale has not accommodated itself to the men's expectations, which seem to have been very much fixed on on the inflated prices current in the market, but not in the manufacturers' books. The strike, however, may be considered at an end, most of the men having returned to reason and to work. It was a brief burst of a temporary disappointment, which has been allayed by the representations of their leaders, who have kept honourable terms with the employers. The manufacturers were rather easy about it, as a few days' continuance would not have seriously inconvenienced them now that business is not so brisk. The Standing Committee stood firmly by the award, and so helped materially to settle the matter. Common bars, £6 5s.; ship-plates, £7 5s. Steam-coal is brisk, but households and manufacturing are not in great request; the same may be said of coke. Prices much the same.

DERBYSHIRE.—The iron trade, notwithstanding the somewhat adverse influences which prevail, is in a pretty active state. The mills devoted to the production of merchant iron are fairly employed, and angle and bar iron is in fair request. The foundries are not over well off for work, and engineers and machinists are not so well employed as either masters or men would wish. The Stanton Iron Company are doing a fair business, and are consuming a good deal of their own coal raised at their pits. The house-coal trade in this district, as elsewhere, is quiet, and so far as appearances go there seems to be no immediate prospect of an improvement. With the vast resources of production the market is over-stocked, and although the tonnage rate to London is fully 1s. per ton less than that charged for the conveyance of South Yorkshire, coalowners, even under these circumstances, find it very difficult to compete with seaborne coal. The new collieries throughout the district are being developed, whilst others are being put down in the neighbourhood of Ripley. Steam and locomotive coal is for the most part supplied on account of railway contracts as well as for blasting purposes, but little being sent away for exportation. Local sales are only moderate, and the same may be said with regard to fuel for engine and manufacturing purposes. There is still a fair business passing in coke, which of late has been increased and also improved in quality. In addition to the district requirements a fair tonnage is dispatched to Sheffield and other places.

DURHAM.—The strike of ironworkers has been the great topic of conversation during this week, as the iron trade has been largely disorganised. The great bulk of the manufactured ironworks of the North are in this county, and with a few insignificant exceptions, these were all laid off in the early part of the week by the men who turned out because the sliding scale awarded them a reduction. The sliding scale had been well considered, and adopted by the men, and if it did not bring out a higher average than £6 2s. 11d. per ton as the net average selling price of iron it only went to show that the employers had a considerable extent of contracts at low prices on hand, and that when they advanced wages in December 12½ per cent., pending the adoption of the sliding scale, which came into operation on the 1st of May, they gave more than the men were entitled to. It seems hard, therefore, on the employers if they are to be subjected to the loss and inconvenience of a strike simply because the sliding scale takes away a portion of the advance which they mistakenly conceded. The bulk of the ironworkers are unreasoning, and though the better men deprecate the step that has been taken, they cannot at all times hold the less sensible of their fellows to the allegiance which they have undertaken to the Board of Arbitration. The result of the strike is that the large works at Consett, Jarrow, Darlington, Stockton, Hartlepool, and Middlesborough have, with insignificant exceptions, been stopped for the time being. The Darlington men resolved to resume work on Wednesday, and others are doing the same. The manufactured iron trade has been in a disturbed condition. Prices have on the week been lower. Ship plates are £7 5s. to £7 10s.; bars, £6 5s. to £6 7s. 6d.; angles, £6 5s. to £6 10s., less 2½ per cent. Puddled bars are £4 12s. 6d. to £4 15s. net. Very few new orders are coming to hand, though it is hoped that lower prices (bars having been offered in some cases at £6) will draw them. The pig-iron trade has been firmer. The returns of stocks showing a reduction of 13,623 tons of pig-iron for last month is very encouraging. No. 3 has been about 39s. 6d. to 40s. The coal trade has been dull, and prices have been going back in manufacturing coal. Coke also has been weaker in price, and 11s. 6d. to 12s. at the ovens is now quoted. The Durham miners have for some time been uneasy, and there has been some talk of restricting the production at the collieries, though such a course is discredited by the great body of the men.

FOREST OF DEAN.—The Cinderford Valley pits are the only collieries of the Forest in which any considerable get of house-coal is taking place. There the output is maintained, and affords nearly full time for the pit men. Quotations just now are uncertain, and it would be rather misleading than instructive to mention prices. The dry weather acts beneficially in regard to the manufacturing classes, especially in districts like that of Stroud Valley, where water is sometimes used as the "motive power." In the western parts of the Forest of Dean there is very little but complaint, and actual suffering from the stoppage of the Parkend Collieries. It was industriously announced this week that the last possible prospect of a restart was gone by, the removal of the pit horses. The story was proved to be a *canard*, and may be traced to the fact that on Monday some forty men at the Royal Pit—who had been kept on coal-getting—were discharged. The terrible blow which the suspension has been can scarcely be conceived beyond that which may be contemplated by a district community thrown out of work. There is plenty of coal, but, until some difficulties have been adjusted between the proprietory, there is but little hope that the position as now created, will undergo a favourable change. It is obvious with such a state of things that the unemployed bread-winners must quit the Forest or submit to the alternative of starvation. As in other parts of the district, there is a good deal of surplus labour. The iron trade continues depressed, and stocks of pig are still increasing. Messrs. Crawshay Brothers, in the Cinderford Valley—as intimated last week was decided upon—have now blown-out one of their furnaces, reducing the number in blast to two, or half their productive capability. This, in fact, represents the entire crude iron made in the Forest of Dean, which is a great misfortune, having regard to the local resources of both coal and iron mine. Messrs. Jacob Chivers and his firm are carrying out some extensions at their Hawkwell Tin-plate Works, being the remaining portion of the original intention when laying down the manufactory. As an acknowledgment of their appreciation of Mr. Keeling's ability in carrying out, as the engineer, of the Severn Bridge, a valuable testimonial has been presented to him by his friends, consisting of a silver candelabrum, value one hundred guineas. Several of the Forest proprietors and traders subscribed, and were of the gathering on Saturday evening, when teh presentation was made, including Sir James Campbell, Bart., Mr. Francis, Crown receiver; Mr. Bright, Hawkwell Tin-plate Works; Mr. W. B. Brain, &c. Mr. Keeling replying, said he strove hard in crossing the Severn to have the bridge as near to the Forest of Dean as possible. There had been clouds and misfortune in the Forest during the last few years, but he felt great faith and confidence that the construction of the bridge will now open up connection with the Forest, that ultimately it must bring great prosperity. It is to be hoped that the prediction may be soon verified.

GLASGOW.—The warrant market has been steady during the week and the fluctuations have been unimportant. Capitalists seem to be getting hold of the idea that warrants are now a safe investment, and large parcels are being bought and taken out of the market, the banks are also aiding this movement by the favourable terms on which they are granting advances. Those most immediately connected with the trade still refrain from buying, and the general impression seems to be that still lower prices will be reached. The shipments are expected to fall off after next week, as no buying has taken place for some time. On Thursday from 46s. 7½d. 47s. 6d. cash was paid, remaining quiet on Friday at 47s. to 47s. 4½d. cash. On Monday there was no market. On Tuesday, opening strong at 47s. 9d. it rose to 48s. 1d., then fell to 47s. cash, remaining steady next day at 47s. to 47s. 3d. cash, closing rather sellers 47s. cash, and 47s. 1½d. a month. Buyers very near. The makers are selling almost nothing at the reduced prices. It is reported that they will reduce their men's wages sixpence per day, and allow the 116 furnaces to remain in blast. No. 1 Gartsherrie is now 55s., No. 3, 50s., No. 1 Coltness 59s., No. 3, 54s.; No. 1 Eglinton 50s., No. 3 48s., but merchants would sell under these prices. The shipments of pig-iron from Scotland last week were, foreign, 13198 tons; coastwise, 4551 tons; total, 17,749 tons, against 12,923 tons in the corresponding period of last year. The shipments for the first four months of this year show an increase of 100,727 tons over the similar period of last year. The imports of Middlesborough pig-iron into Grangemouth last week were 3330 tons, against 2010 tons in the corresponding week of last year. The total imports of Middlesborough iron till May 1st, 1880, are 75,670 tons, against 83,597 tons till May 3rd 1879, showing a decrease for this year of 7927 tons. A small quantity of iron is again going into Connal's store, and the stock there now amounts to 438,486 tons. The manufactured iron trade is very dull, and few new orders are being received even at the reduced quotations, in some cases the heavy rolling mills are well employed, but the mills for small sizes are nearly idle. The exports last week were considerable, the chief item being steam-engines for Palermo valued at £17,000, machinery for Calcutta at £10,510, wrought-iron goods at £7434, and cast-iron goods at £4160; machinery for the Continent at £6203, cast-iron goods for Rangoon at £2231, with machinery at £2074, and for Berbice machinery at £1600. Orders for one or two more vessels have been placed with Clyde shipbuilders during the week, but the launches are rather in excess of the new orders. The engineering trades are dull, and the general business of the city is very quiet. Little is doing in the coal trade, and there are few enquiries either for export or home use.

LANCASHIRE.—There are some slight indications of recovery in the iron trade of this district, but any real improvement in the market so far as actual legitimate business is concerned, is still very small. There is, however, more disposition to buy, and a fair amount of inquiry was reported at the Manchester weekly meeting on Tuesday. Where iron could be bought for delivery over the year at the lowest prices, speculative purchasers appeared willing to invest, and I heard of some tolerably good lots being placed. There is, however, still a good deal of underselling on the part of merchants, and iron which has been bought for shipment is being forced on the home market at low prices, dealers who have made a good profit upon the rise being in many cases now prepared to pay the differences on the iron still remaining in their hands rather than hold it for a prospective return in the demand for export. In Lancashire, pig-iron there is still but little doing, and I hear that loral makers are unable to get buyers of considerable quantities of iron to take their deliveries, the result of which is that stocks are accumulating at the works. For delivery into the Manchester district 55s. per ton, less 2½ per cent., is still quoted for foundry and forge qualities, but a less price than this would be taken to effect sales. The Wigan Coal and Iron Company have blown out one of their furnaces for repairs. Lincolnshire iron is being offered by makers for delivery equal to Manchester at about 56s. per ton, less 2½ per cent., and at this figure some iron has been sold, but there are secondhand parcels offering at lower prices. For good brands of Middlesborough iron delivered equal to Manchester makers are asking about 48s. 4d. per ton net cash; but there is iron to be bought in the market for 1s. to 1s. 6d. per ton less, and at the lower figures transactions are reported. In the finished-iron trade there is but little doing. The local forges are still fairly supplied with orders. Merchants are still offering secondhand lots at much below makers' quotations, bars delivered into the Manchester district being offered at from £7 to £7 5s. per ton, and hoops are reported to have been sold at as low as £8 per ton, these figures being 15s. to 20s. per ton under the prices ruled by makers.

LEEDS AND WEST YORKSHIRE.—No fresh impetus has been given practically to the West Yorkshire iron trade of this district. Nothing has occurred, however, to give rise to discouragement. Rather otherwise, for the several large forges both in the Leeds and Bradford district have been visited during the week by Government and other consumers' representatives. In this we may reasonably suppose there is a good augury, but for the present, gratitude for favours to come has, to a great extent, to suffice those who are anxious that before the expiration of the first half of the year, which is fast hastening on, there should begin to appear better assurances than there have been so far of a permanent improvement in this particular trade. Hitherto, the orders for shipbuilders', railway and engineers' work have come in but fitfully, and never in such abundance or substantiality as to ensure a higher average than of from three to four days' weekly work. All this, there is good reason to believe, will be changed for the better before long; and there will soon not be so much difficulty as hitherto has been the case in getting specifications connected with engagements which some time since were entered into. All during the last two months, too, our ironmasters—best and common makers alike—have been particularly careful against working to stock. The disturbance in the North of the relations between employers and employed does not much affect this district; and, indeed, it is scarcely possible that it could do so, except on comparatively a very small scale. Locomotive-engine building is by no means going on at an ever-increasing rate. It is only one large firm, perhaps, which has as much work to cope with as is convenient. The makers of tank-engines would be found capable of turning out much more work than at present they are privileged to do. There is, certainly, so far as agricultural machinery is concerned, a considerable improvement in the demand, but it must be remembered that it is not long since this demand was almost at zero, and that even now the number of hands employed contrasts unfavourably with the extensive premises which were built and enlarged in the hey-day of national prosperity. Machinery for all branches of the textile manufacture is in good demand. Such firms as Fairbairn, Kennedy and Naylors, and the Lawsons, as well as some of the Bradford and Keighly machinists, are employing treble the number of men they did three months' since. Owing to the slacknesss in the building trade founders are not in a very enviable position; and even the importation of Belgian girders, &c., has fallen off considerably. There is nothing new to mention in connection with the coal trade. Prices are unchanged and the demand flat. At the Whitwood Collieries the men have managed to get up a little excitement over a proposal that the pay days shall be fortnightly instead of weekly, and this has afforded an opportunity to the officials of the West Yorkshire Miners' Association for for trying to rally more of the miners of the district to their standard.

LONDON.—The metal market has shown much uneasiness during the past week, and prices have fluctuated a great deal, but rather with a downward tendency. In spite of this, however, business is more stirring, and better prospects seem held out. Iron-pigs have receded to 46s. 7d., with slow business. Manufactured is sold at prices which meet the need of makers. Copper dull; Chili bars close at £57. Tin.—A great deal has changed hands, and the prospects of higher prices seem certain, judging from the position of the article. English firm at £86; Foreign, after rising to £85, and receding to £77 10s., closes firm at £80. Lead quiet at £16 English, with little doing. Tinplates are much firmer, the proposition to reduce make has bas brought forward buyers. Cokes, 19s. to 21s.

NEWCASTLE AND THE TYNE DISTRICT.—The rupture between the ironmasters and their workmen has caused some uneasines here but on the whole the state of the iron trade shows fair improvement. There are more inquiries, induced by the belief that prices of pig-iron had touched their lowest, and that a gradual rise would follow. No. 3, pig now brings 40s. to 40s. 9d. per ton here, showing a rise of about 4s. per ton in the open market, and makers are still chary of entering into contracts except at prices considerably above those of merchants. Manfacturers keep fairly busy where the strike has not stopped work, but in the market rates for bars, plates, &c., have yet a downward tendency. An early adjustment of the wages dispute is confidently looked for, and in the meantime all ordinary wants can be supplied without difficulty. Works in our engineering establishments and iron shipbuilding yards show no diminution, but for a few weeks past builders have had fewer inquiries. This is to be attributed to the unsettled state of the iron trade; but if prices of manufactured iron continue on the present low scale there is a strong probability that orders for new steamers will be received. Freights generally are lower. At Palmer's Jarrow shipyard there is much activity, two large vessels being ready for launching, and others approaching completion. At Elswick the Ordnance Works of Sir William Armstrong and Co. are full of work; two shifts of workmen per diem are employed, and have for some time past, whilst the engineering departments maintain the steadiness reported a couple of months ago. The great engine manufactories in the town of Newcastle and Gateshead, including those of Messrs. R. Stephenson and Co., Messrs. R. and W. Hawthorn and Co., Messrs. J. and G. Joicey, Messrs. T. Clark and Co., the North-Eastern Railway Company, Messrs. Black, Hawthorn and Co., Messrs. Hawks, Crawshay and Sons, and a few more firms, are all employed very well indeed, but without such pressure as to make the working of overtime a necessity except on rare occasions. In the steam-coal trade quietness prevails. The quoted price of 10s. per ton is quite 6d. to 9d. per ton more than it should be. Gas-coal mines are, on the other hand, very busy, and working full time; the price for the best coals of this class is 7s. 6d. per ton, free on board, less 2½ per cent. House coals are in little request, the very best sorts, screened, selling with pressure at 8s. 6d. to 9s. 6d. per ton shipped in the Tyne Dock or at Sunderland.

NORTH LINCOLNSHIRE.—The state of the iron trade in this flourishing district holds well up, considering that prices have of late declined. The make of pig-iron is just now, perhaps, larger than it ever was since the first furnaces were erected in 1860. The work of rebuilding the two new stacks at the Trent Works is progressing, but a considerable time must elapse before they can be brought into requisition. At some of the works stocks of pig-iron are to be seen, but these it is said are awaiting the orders of the claimants. There is still a large business doing in ironstone for which the district is so noted. In addition to the increasing requirements of the district a large tonnage is being sent away by rail to various parts of Yorkshire and other places. The importation of coke continues to hold well up, and in this department also the quantity received was never so large. The impetus which has of late been given to the district railway traffic has been remarkable.

NORTH STAFFORDSIRE.—There is no appearance of any improvement in the demand for finished iron, and the outlook is hardly more encouraging than it was a year ago, notwithstanding the great change which has since passed over the trade, and which, but a short time ago, was thought to have ushered in a long era of prosperity. The dulness of the home market, so frequently noticed of late, continues unchanged, and foreign buyers are still conspicuous by their absence. There are a good many inquiries in the market, but they do not appear likely to develop into orders until a much greater drop in prices tempts the inquirers to enter into contracts which they now fight shy of. Many of the bar mills are being put on short time, and as the orders on the books are being rapidly worked off, and the new orders are few in number, some of them will be brought to a standstill, and the rest put upon shorter time if fresh specifications do not quickly come to hand. The department in which the most life appears to exist just now is that of heavy engineering sections. It is scarcely necessary to say that prices are receding, although makers of well-known brands are reluctant to reduce. Unmarked iron is realising generally low rates. Business in pig-iron and ironstone, in keeping with the finished iron trade, has fallen off considerably of late, and prices are weakening. Dulness prevails in the coal trade, both as regards manufacturing and house fuel, and, as a rule, prices are unremunerative. In several parts of the district wages have been reduced, and in the neighbourhood of Talke some 2000 men are on strike against a drop of 10 per cent. If the demand does not improve, a general lowering of wages is not improbable.

SHEFFIELD.—The tone of the iron market this week is duller than was the case at the close of the past month, and there is a complete absence of speculation. The prospect at present is not very encouraging, and it is not anticipated that there will be any immediate revival in prices, even if the present ones are maintained through the month. There is a steady call for Derbyshire makers, and Lancashire buyers are inquiring more freely, owing to heavier shipments during the past week. The manufactured-iron department is steady, but not brisk. The demand for ship-plates is on the increase, reduced rates having stimulated the trade, and orders which would have been executed in the North but for the men being "out," are finding their way into South Yorkshire. Steel ship plates are also being inquired after for vessels of light draught, and this branch bids fair to become a most important one. Steel boiler plates are also being sent out largely, but the boiler trade generally is stagnant, some of the hands having been out of employment for months. Armour-plate manufacturers are again busy, the new composite makes having answered all expectations. Though the armour plates of the future will be much thinner than the bulk of iron issued from the Sheffield mills on the old principle, the resistance to shot by the former has been found more effective. The men anticipate being allowed shortly to run full time, and as during the series of experiments which have led up to the composite plate many of them have been "thrown out" the change is a welcome one. The Bessemer department is full of work, both on railway material and the issuing of billets for other purposes. The market has not recovered from the drop of last week. Best billets are quoted at £9, but in quantity they are obtainable at £8 10s., and some heavy transactions at the latter figure took place at the commencement of the week, speculators coming forward at the latter rates. Coal and coke, the latter especially, from the North, are meeting a slower sale, and Durham has been offered 1s. lower than last week—27s. 3d. in Sheffield. Local made varies from 19s. to 22s. per ton. File houses are especially busy, and are reducing their discounts from the "standard," thus sending up rates. In every probability prices of files will advance during the summer. Cast steels realise the full rates of last month, but there is no addition to note. Some leading converters are very busy; these houses in October last were slack of work. In the cutlery market there is a deluge of orders for inferior descriptions, ostensibly for competition with the German producers. Prices are consequently low, but manufacturers are finding a better demand for first-class goods, and this will check the downward course of rates, and in a few months we shall have to chronicle advances. Raw material is dear, and as soon as the stocks of raw material have been used up the market will reassert itself. The present is the turning point with regard to the old staple trades of the town, and an improvement is confidently looked for. Sheep shear and edge tool manufacturers are very busy.

THURSDAY.—Bessemer billets have fallen 20s. per ton in the market this morning; but are now quoted at £7 10s., and a further fall is anticipated.

SOUTH STAFFORDSHIRE.—Travellers' order sheets are not improving to any appreciable extent in the chief hardware branches. Some makers there are, however, and certain of the japanners are conspicuous, who report an increase of home business. The monthly Australian mail, delivered since last report, has proved of more value than many merchants had looked for, nevertheless galvanised sheets and similar heavy goods are not largely ordered. The West Indian mail was an average, particularly from Cuba. Alike in the iron braziery department and in sheet branch, the galvanisers are experiencing a sensible falling away in the demand, and workmen are being discharged. The wrought-iron tube makers are doing most in gas and boiler sorts. The work under execution is chiefly for the home market, but some good shipments have recently been made to Canada. Prices are low and varied. The foreign business in cultivating tools is improving. Valparaiso, Chili, Brazil, Bombay and Calcutta are all taking large quantities. Manufactured iron is slow of sale, and new orders are badly needed. Marked bars are £9, sheets (singles) £9, and common bars £7, and less. Stocks of pig-iron in makers' hands are increasing. All-mine iron is £4 for hot-blast sorts, and cinder iron is £2 10s.

WEST CUMBERLAND.—A very slow demand exists for hematite iron, and makers during the past few days have only done a small business. The market, in fact, is presenting evidences that it will further decline before any action in another direction takes place. Buyers are not making many inquiries, and makers being busily employed on old contracts are not pressing sales. The whole position is one of transition. Buyers have purchased too heavily at high prices, and makers have sold so well forward that for the present they are independent of any influences which are affected by supply or demand. The general belief is that so soon as makers have disposed of the large contracts they are holding buyers will be induced to speculate on the ground of cheaper prices, and that a steady trade will follow on a more healthful basis. Such excesses of demand and such rapid advances in prices as have been experienced of late must inevitably result in a reaction such as the one now experienced. There are indications, however, in the future that trade will be good and steady, and as this district may and probably will, be called upon to supply a large proportion of the metal required for the steel manufacture of this country there is everything to make manufacturers, who are already busy and likely to remain so for some time, hopeful of the future. Iron ore is quieter in tone, but large deliveries are still being made to local smelters and others. The coal trade, on which this district so greatly depends, is quiet, although there is a little improvement on the Irish demand. Household qualities are in small request on account of the season, but manufacturers require very large supplies. Shipping busy.

CONTINENTAL MINING AND METALLURGY.

IT is a little difficult to define the general situation on the Continent, the features of which are so contradictory, except by contradictory terms. If we say that trade is both good and bad and neither good nor bad, we shall have summarised the various accounts which have reached us concerning it, but we are not sure that this characterisation will be found satisfactory, however true. Buyers are holding back, and so are makers, while middlemen have more than enough in hand to supply current needs at rates which exasperate makers without tempting buyers. The general sense of the leaders of opinion is that the market will certainly recover the firmness it has lost during the present period of forced realisation, and that then business, as always happens with a rising market, will begin again to crowd in. After June, therefore, prices are likely to settle on a satisfactory level, at which business will go steadily forward. For how long, no one ventures to say; for ourselves, our faith does not hold out beyond next spring.

FRANCE.—Although, says *L'Ancre*, wants are not few and business is not scarce at Paris, the course of trade is far from smooth, from the belief on the part of buyers that prices are doomed to a further fall. But speculators' stocks must run out sooner or later, and buyers will then have to turn to the forges, on whom the lesson of March and April will not have been lost. Besides, they are still in a position to hold out for some months to come. Plates are still firm at 280 fr. (£11 2s.) at the forge, or 300 fr. (£11 18s.) to the Parisian consumer, but the latter price has lately been underbid by Belgian dealers.

The Comité des forges met on the 19th inst., devoting its time chiefly to the work of internal organisation. The appointments made at its last meeting (see our number for April 2nd) were confirmed, and M. Ferdinand Gautier, formerly of the Terrenoire Works, a gentleman whose face and voice are familiar to visitors to the meetings of the Iron and Steel Institute, has been appointed secretary to the Comité. M. Gauthier is, or has lately been, on the staff of our eminent contemporary, the *Annales industrielles*. M. Desbrières keeps his title of honorary secretary.

The Nord forgemasters held their last monthly meeting at Maubeuge on the 22nd ult., and discussed the tariff movement very anxiously. It was decided to maintain the rate, now some months old, of 240 fr. (£9 10s. 6d.) for merchant irons and 250 fr. (£9 18s. 6d.) for I-irons, at the forge. These prices are held with tolerable firmness by the forges, but it was stated that sundry merchants were underselling.

In Haute-Marne ironmasters are too full of business to appear in the market. Sales at second-hand are made at the rate of 90 fr. (£3 11s. 6d.)

The forgemasters of the Loire and Rhone continue to have an absolute and unwavering faith in their own good fortune, and are only waiting for the end of June to arrive to see unprofitable contracts at an end, and the artifices of middlemen frustrated. There are two works in the Centre gorged with tires; the Marine Steel Works have been compelled to add to their already extensive plant to overtake orders in axles and other forgings.

M. Laur reports that at the Decazeville works a process has been experimented with for dephosphorising with alumina instead of lime. The process turns on the stability of phosphate of alumina at high temperatures. The phosphate of alumina is formed at the temperatures at which silicon has decomposed the combinations of lime and magnesia. If a melted aluminate is introduced into the bath, then at the moment of highest temperature, when the phosphorus is most inclined to combine with the metal, it is laid hold of by the alumina and "engaged to take part in an industrial combination," like a shareholder.

The following are the import duties on the more ordinary classes of metallurgical goods which have been voted by the Chamber of Deputies, most of them being lower than the proposals of the Tariff Commission:—

	fr.	£	s.	d.
Pig-iron	20·00 ..	0	15	10
Raw iron, with 6 per cent. or more cinder	45·00 ..	1	15	8
Bars	60·00 ..	2	7	6
Hoop-iron over one millimetre thick	60·00 ..	2	7	6
,, under ,, ..	75·00 ..	2	19	6
Wire rod	60·00 ..	2	7	6
Plate, over 1 millimetre thick..	75·00 ..	2	19	6
Sheet, 1 millimetre and under	100·00 ..	3	19	4
Iron-wire, over 1 millimetre	60·00 ..	2	7	6
,, 1 millimetre and under	100·00 ..	3	19	4
Steel rails	60·00 ..	2	7	6
Other steel goods	90·00 ..	3	11	6

BELGIUM.—The *Moniteur belge* publishes the following statistics of Belgian metallurgical imports and exports for the first quarter of the present year, comparing them with the figures relative to the corresponding periods of 1879 and 1878:—

	1880.	1879.	1878.
Imports:—	tons.	tons.	tons.
Steel (all classes) ..	1582	621	1218
Pig-iron	73,176	—	—
Scrap	5463	—	—
Wire	1154	671	971
Rails (iron)	18	774	30
Plates	98	31	40
Section irons	2219	889	964
Nails	198	81	94
Unclassed irons ..	892	632	765
Castings	801	326	255
Ores, borings, &c. ..	166,428	169,768	199,177
Coal	239,445	177,232	168,687
Coke	3506	2391	4210
Exports:—			
Steel (all classes) ..	7147	6955	2489
Pig-iron	4740	—	—
Scrap	12,771	—	—
Wire	1317	629	431
Rails (iron)	6010	4470	3952
Plates	6487	4656	3812
Section irons	46,307	28,362	25,418
Nails	3417	1719	1839
Unclassed irons ..	4309	3776	4536
Castings	3563	2557	768
Ores	68,368	59,195	67,497
Coal	1,143,188	996,307	801,236
Coke	200,745	143,316	127,834

We will summarise these figures next week, in accordance with the custom we observe each quarter.

Firmness, at a low level of rates, is just now the characteristic of the Belgian market, which thus prefigures the next probable phase of all European markets. Orders are being worked down, but there are known wants in existence. Any future improvement is likely to begin with steel.

GERMANY.—Prices are sinking and orders are getting scarce in Westphalia. In Siegerland low prices do not tempt buyers, and new business is rare to meet with. There are some mines and mills fortunate enough to have remainders of long-term contracts before them, but there are several mines and furnaces which are unable to find contracts to replace those worked out. The output of ironstone is being continued briskly, in the hope that business will presently take a turn; meanwhile stocks have begun to accumulate. Carbonated ores are being offered at 145s. per 10 tons, and brown hematite at 160s. Negotiations are on foot for American exportation, and samples of roasted spathose ores have been forwarded to the States. The plate mills are mostly working for stock, dealers in South Germany cannot get and will not pay the late winter prices, and forgemasters, as well as dealers, are staying away from market in the hope it will improve in their absence.

Better reports come from the Lorraine ironworks, which find themselves in quite a normal condition of activity. Work comes in freely at satisfactory prices, not too high or too low, but such as both sides hope can be kept up for some time to come. The ironworks in Rhenish Westphalia are making large demands for Lorraine ironstone.

Certain branches of machine construction ("engineering") are doing well in Chemnitz. Orders for spinning and weaving machinery come in from Saxony, the Rhineland, Russia, Italy, Spain, Denmark and Sweden, to say nothing of China and Japan. In steam-engines Chemnitz feels the competition of Sulzer, of Winterthur, who is now building new works in Ludwigshafen. Machine tools are dull; scarcely a third of the existing plant is engaged, and prices bring no profits. Locomotive building is at a standstill and scarcely a builder but finds it difficult to keep the nucleus of his staff of workmen together.

Glaser's *Annalen* tells us that German foundry pig, sinking in sympathy with the fall in Scotch quotations, has gone down to 75s. for No. 1, which is from 25s. to 30s.

lower than the highest prices got this year. In places like Magdeburg, Berlin, &c., were water carriage exists, Scotch pig-iron is just now cheaper than German; but not in places reached only by rail, and railway directors are reminded of their *duty* to reduce the cost of carriage of native-made pig. With two exceptions German pipe founders are poorly employed. Unless the railway or some one else gives native smelters assistance, foundry pig making in Germany will shortly become a very unprofitable industry.

On March 15th the Alta Italia railway let a contract for 8000 tons steel rails to Bochum at £9 6s., delivered at Genoa, and £9 8s. 9d., delivered at Venice. The Ferrovie Romane have let to the same company a tender for 2000 tons steel Vignoles rails, 9 metres (30 feet) long, and the Ferrovie meridionali have sent to a Chemnitz firm (Sachsische Maschinenfabrik) for six large locomotives for the Calabro-Sicilian lines.

PRICES.—In the following table we give a comparative view of the current prices of the chief articles of metallurgical commerce. The weights, of course, "short" tons:—

	Paris.	Hte.-Marne.	Brussels.	Dortmund.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Forge pig ..	—	2 11 6	3 7 6	4 10 0
Foundry pig ..	—	3 19 6	—	4 0 0
Bessemer pig ..	—	—	—	6 0 0
Beams ..	10 2 6	—	—	8 10 0
Merchant irons.	9 14 6	9 18 6	6 0 0	8 5 0
Plates ..	11 18 0	—	—	13 0 0
Bessemer rails.	—	—	—	11 5 0
Old rails ..	5 9 0	—	—	—

NEW PATENTS.

ALL the Patents are placed Alphabetically, with the official numbers attached. The New Applications range from No. 1712 to No. 1814, being the entries from April 27th, to May 3rd.

NEW APPLICATIONS.

Air and Vapour Pumps.—A communication.—*C. Pieper, Berlin, Germany.* [1801

Air-tight Manhole Flap.—*A. T. Angell, London.* [1765

Amylaceous Compound.—*W. C. Locke, London.* [1814

Apparatus for Tilting Barrels.—*W. Horner, Manchester.* [1768

Aspirators.—A communication.—*S. Bowden, London.* [1753

Bicycles.—*F. W. Jones, Exeter.* [1742

Bottle Manufacture.—*W. W. Macvay, Castleford, Yorkshire.* [1730

Bookbinding.—A communication.—*A. C. Henderson, London.* [1712

Braces or Suspenders.—A communication.—*E. Edwards, London.* [1717

Brake Apparatus.—*P. Everitt, London.* [1718

Brick Manufacture.—*R. Garsides and G. Sewell, Barton-on-the-Humber, Lincolnshire.* [1750

Butter Working Machinery.—*G. M. Allender, London.* [1809

Calcining Ores.—A communication.—*W. R. Lake, London.* [1798

Caloric Engine.—A communication.—*P. O'Halloran, Chancery Lane, London.* [1799

Carriage Roof Lamps.—*J. A. Dryden, London.* [1725

Cask Lowering Machinery.—*A. W. Hay, London.* [1783

Chaff-Cutters.—*A. McGregor, Leigh, Lancashire* [1804

Clock-Winding and Regulating Machine.—A communication.—*W. R. Lake, London.* [1808

Collapsing Carriage for Boats.—*F. E. Todd, York.* [1728

Composition for Ships' Bottoms.—*H. P. Scott, South Shields, and T. D. Donaldson, Jarrow-on-Tyne.* [1755

Concrete Pipe.—A communication.—*W. R. Gedge, London.* [1786

Constructing Concrete.—*J. P. Waterson, London.* [1789

Copying Presses.—*P. M. Justice, London.* [1737

Device for Hanging Pictures.—A communication.—*W. R. Lake, London.* [1795

Drinking Vessels.—*J. Shepherd, Manchester.* [1739

Dyeing, &c., Textile Fabrics.—A communication.—*J. H. Johnson, London.* [1771

Electric Signal Apparatus.—A communication.—*W. Morgan-Brown, London.* [1751

Fastenings for Gloves, &c.—*J. Whitby, Yeovil, Somersetshire.* [1719

Fire Extinguishers.—*W. Nassen, Newcastle upon-Tyne, and E. Hallgren, Gateshead-on-Tyne.* [1716

Fireproof Safes.—A communication.—*L. A. Groth, London.* [1763

Fittings for Baths.—*J. McL. McMurtrie, Glasgow.* [1791

Foot Warmers.—*J. M. Dassy, Paris.* [1790

Fulling Stocks.—*L. Webster, Dewsbury, Yorkshire.* [1748

Furnaces for Pulverulent Fuel.—A communication.—*H. A. Bonneville, Paris.* [1797

Gas Engines.—*C. M. Sombart, Magdeburg, Germany.* [1736

Harvesting Machines.—*G. Kearsley and E. Whitworth, Ripon, Yorkshire.* [1741

Heels for Boots and Shoes.—A communication.—*W. P. Thompson, London.* [1773

Horse Collars.—*E. Paquis, Humbecourt, France.* [1787

Horse-shoes.—A communication.—*W. R. Lake, London.* [1747

Ice-making.—*C. C. Palmer, Oaklance, U.S.A.* [1752

Improved Jacquard Apparatus.—*J. Clayton and T. Richmond, Burnley, Lancashire.* [1775

Lamps.—*J. J. F. Stevens, London.* [1793

Lasting Boots.—*J. Lindley, Leeds, Yorkshire.* [1731

Lawn Mowers.—A communication.—*J. P. Lawrence, Finsbury, London.* [1769

Leather Manufacture.—*B. and D. Wright, Leeds.* [1784

Lever Slide Seat for Vehicles.—*C. Keen, Farnham.* [1800

Liquor Case.—*J. N. Mappin, London.* [1760

Locks and Latches.—*J. M. Hart, London.* [1785

Lubricating Apparatus.—A communication.—*G. W. von Nawrocki, Berlin.* [1722

Lubricating Apparatus.—A communication.—*J. T. King, Liverpool.* [1727

Marine Steam Engines.—*H. B. Young, London.* [1729

Metallic Railway Sleepers.—A communication.—*C. D. Abel, London.* [1758

Mineral Oils and Wax.—*J. Broad, London.* [1794

Navigating the Air.—*M. Hill, Birmingham.* [1776

Non-Conducting Jackets.—A communication.—*B. J. B. Mills, London.* [1777

Oleomargarine.—*M. I. Emanuel, London.* [1767

Oil Cake.—*M. Gandy and C. S. Brittain, Liverpool.* [1732

Oil-Pressing Apparatus.—*R. P. Thacher, Liverpool.* [1734

Osseous Compounds.—A communication.—*W. Morgan-Brown, London.* [1721

Paper-making.—*J. C. W. Stanley, London.* [1735

Paper Staining Machinery.—*A. Siebert, Gummersbach, Germany.* [1802

Parcel Carrier.—*G. C. Wallich, London.* [1766

Preparing Iron for Coating with Metal.—*F. Braby, London.* [1788

Presses, &c.—*M. Stonehouse, South Stockton-on-Tees.* [1723

Preventing Boiler Explosions.—A communication.—*A. M. Clark, London.* [1749

Printing Machines—A communication.—*F. H. F. Engel, Hamburg, Germany.* [1805

Printing on Glass, &c.—*J. J. Emery, London.* [1759

Railway Brakes.—*S. Carwell, Hendon, Middlesex.* [1756

Railway Coupling Apparatus.—A communication.—*W. R. Lake, London.* [1778

Railway Keys.—*S. Wilson, Athlone, and L. Wilson, Manchester.* [1762

Railway Vehicles.—*C. Barrett, Somerville, U.S.A.* [1744

Railways.—*J. W. Hartley and C. M. Campbell, Stoke-upon-Trent.* [1813

Registering Apparatus.—A communication.—*H. H. Lake, London.* [1724

Riveted Joints.—*P. Samson, Forest Hill.* [1740

Roundabout Carriages.—*W. Sanger, Margate, and F. Savage, King's Lynn, Norfolk.* [1812

Safety Lamps.—*H. B. Fox, Oxton, Cheshire.* [1733

Sashes and Sash Frames.—*J. Boulter, Cardiff.* [1757

Self-Feeding Skep.—*C. R. Parkes, London.* [1761

Self-Filling Buckets.—*G. Allix, London.* [1811

Sewing Machines.—*J. Edwards, Aldershot.* [1714

Ships' Berths.—A communication.—*A. M. Clark, London.* [1726

Show Cases.—*J. Kershaw, London.* [1774

Steam Boiler.—*A. Dervaux, Brussels.* [1746

Steam Ships and Boilers.—*W. Gray, Dawlish, Devonshire.* [1779

Steam Water Heater.—A communication.—*F. H. F. Engel, Hamburg, Germany.* [1806

Stench Trap.—*M. Wilson, London.* [1781

Street Sweeper.—*W. Smith, Barnard Castle, Durham.* [1772

Sweeping Machine.—A communication.—*J. H. Johnson, London.* [1782

Telegraph Wires.—*J. R. Edwards, Liverpool.* [1720

Telephones.—*R. and M. Theiler, London.* [1764

Telephony.—*S. Russell, Brooklyn, U.S.A.* [1738

Transport of Earth.—*H. Rider, Wellingborough, Northamptonshire.* [1780

Tube Expanders.—A communication.—*G. Sonnenthal, Queen Victoria Street, London.* [1754

Unions for Joining Pipes.—*J. Whitehead, Lockwood, near Huddersfield.* [1713

Valves and Valve Gear.—A communication.—*J. H. Johnson, London.* [1715

Venetian Blinds.—A communication.—*F. H. F. Engel, Hamburg, Germany.* [1807

Ventilating Air Brick.—*J. Gilmore and W. R. Clark, Lower Norwood, Surrey.* [1796

Waste Valves.—*T. B. Plumtree, Wimbledon.* [1803

Waterclosets and Lavatories.—*T. G. Messenger, Loughborough, Leicestershire.* [1745

Water Motor and Meter.—Partly a communication.—*J. MacFarlane, Glasgow.* [1792

Waterproof Material.—*J. G. Hey, Cleckheaton, Yorkshire.* [1810

Wheeled Vehicles.—A communication.—*P. Pitt, Sutton, Surrey.* [1743

Wire Ropes.—*W. T. Cheesman, Hartlepool.* [1770

COMMERCIAL.

J. BERGER SPENCE AND CO.'S WEEKLY REPORT.

CHEMICALS.—A continuance of the depression recently noted has characterised our marked again this week, a manifest anxiety on the part of speculative holders to realise being apparent on all sides—but more especially as effecting alkali products, large quantities of bleaching powder, ash and caustic soda, all of which were largely bought in September and October at inducing prices, to a great extent in anticipation of a prolonged foreign demand, which, to a great extent, collapsed for the time being. Considerable quantities of these others, originally intended for export, have been thrown on the home market, and disposed of at the best obtainable prices. As manufacturers are, generally speaking, well sold for some few months forward, we cannot anticipate any immediate reaction of prices in the favour of sellers; but when the present unsatisfactory condition of the market comes to an end (which is simply a question of a short time), and the manufacturer assumes his proper position, and is enabled to regulate the prices of his productions by the well-defined laws of supply and bona fide demand, we may confidently look for a speedy improvement in values. no transactions of importance are reported for export, and limits in the hands of merchants, pronounced out of the reach of sellers a week ago, have been altogether withdrawn, pending a more settled condition of the market. A rather firmer tone was experienced on the Tyne early in the week, more particularly in the value of soda crystals. Prices have since, however, become weaker. Bleaching powder is offered freely at tempting prices for prompt delivery, forward supplies are not as readily obtainable. Soda ash and caustic soda remain dull and neglected. A moderate business may be referred to in carbolic, picric and oxalic acids at recent quotations. Acetate of lime in less demand.

MINERALS.—An unmistakable sympathetic feeling between the mineral and metal markets is still perceptible, and they are both suffering severely from the sudden depression. Business of any moment in the coal districts there has not been during the week, and prices are, if anything, a shade easier at the moment. A few unimportant orders and enquiries may be noted for export, and in several instances, stocks have been diminished on this account. Ores of all descriptions remain neglected, and holders would gladly arrange sales upon special terms, to move stocks both actual and perspective. Brimstone has not undergone any important change in value, although the demand is rather weaker. Umber and ochre move off very slowly at late rates. Better prices are confidently looked for by holders of China clay. Stocks at the outports have recently decreased, and the increased warehouse charges now becoming general, at Runcorn and elsewhere, will doubtless have the effect of somewhat reducing the shipments from the mines.

METALS.—A very much better tone has this week been apparent in the chief pig-iron markets, and if prices have not improved to any considerable extent, the rapid downward tendency may be said at any rate to have been arrested. As the week closes, both Middlesborough and Scotch markets show decidedly more firmness, and sellers in the majority of instances are now holding for higher rates, and a corresponding eagerness may be noticed on the part of buyers to cover their present, and if possible, forward requirements. It is very satisfactory to note even the indication or more remunerative prices for the manufacturers, and we have no doubt, with the example of the last three months still fresh upon the minds of both buyers and sellers, that the reign of feverish anxiety which has prevailed in the metal market generally will not rapidly be removed. After receding to 45s., Scotch warrants close at 48s. 1½d. Hematites remain moderately quiet at 85s. at the works. Both tin and copper are in better demand at increased prices. Lead is rather easier, and a few transactions are reported. Spelter is steady at late rates.

Manchester, May 1st, 1880.

DIARY OF FORTHCOMING SALES.

NOTICES OF SALES OF ENGINES, PLANT, AND MACHINERY, IMPLEMENTS, MINES AND COLLIERIES.

For Particulars of entries see Advertisements at end of Paper.

PLACES OF SALE.	PROPERTY FOR SALE.
On Great Northern.	Engineering Business.
Wexham.	Broughton Hall Iron Works.
Liverpool.	Hand Leather, &c.
Durham.	East Hetton Colliery.
Northamptonshire.	Mineral Property, Woodford House.
Forest of Dean.	Iron Mines.
Bradford.	Graham Steel Foundry.
London.	Ironmonger's Business.

NEW COMPANIES.

DOWSON ECONOMIC GAS.—Upon terms of an agreement of 6th ult., this company proposes to purchase and work the letters patent granted to Mr. J. E. Dowson for improvements in apparatus for the manufacture of gas. It was registered 21st ult, with a capital of £8000 in £50 shares. The purchase consideration is £6000 in fully paid B shares.

DRAKE'S PATENT CROWN STEEL WORKS.—Upon terms of an agreement of 24th ult, this company proposes to purchase the several letters patent granted to Mr. William Drake, of Lewisham, for improvements in the manufacture of iron, steel, and other metals. It was registered 27th ult., with a capital of £60,000 in £10 shares. The consideration is £20,000 payable, £3000 in cash, and £17,000 in fully paid up shares.

FUEL SUBSTITUTE.—This company was registered 24th ult., with a capital of 15,000 in £100 shares, to acquire and work patents for the manufacture of artificial fuel and other heat producers.

HAMER'S MERCANTILE.—This company proposes to deal with coal, coke, lime bricks, tiles, slates, artificial manures, explosives, building and other mining materials, fabrics, and articles of every description. It was registered 27th ult., with a capital of £6000 in £1 shares.

HAWKSTOR CHINA CLAY.—Upon terms of an agreement of 20th ult., this company proposes to acquire land at Hawkstor, parish of Blisland, county of Cornwall, for digging and disposing of the china stone, pottery, and other clays lying thereon. It was registered 27th ult., with a capital of £10,000 divided into 5000 A (10 per cent. preference) shares of £1 each and 5000 B shares of £1 each. The purchase consideration is 5000 fully paid up B shares.

INDIAN GOLDFIELD CO-OPERATIVE ASSOCIATION.—This company was registered 27th ult., with a capital of £1,200,000 divided into 1000 proprietors' shares of £120 each, and 90,000 investors' shares of £12 each, to carry on the business of miners and prospectors, and to acquire and work gold and other mines in India and elsewhere.

MINAS AND RIO RAILWAY.—This company proposes to acquire and carry out the concessions granted by the Brazilian Government and the Provincial Goverument of Minas Geraes for the construction of a railway between the D. Pedro II. Railway in the province of St. Paulo and the town of Tres Coracoes, in the province of Minas Geraes. It was registered 24th ult., with a capital of £1,000,000 in £20 shares.

TREMADOC SETT AND PAVING STONE.—This company proposes to acquire the interest of Edward Stutchbury, Esq., of Bristol, in rocks, beds, and veins of stone upon certain lands in the parish of Penmorfa, county of Carnarvon. It was registered 22nd ult., with a capital of £15,000 in £50 shares.

LONDON PRICE LIST OF METALS, ORES, OILS, CHEMICALS, &c.

[FOR THE PRESENT AND PAST WEEK.]

Metal Market, City, Thursday Afternoon, 4 P.M.

(*May* 6, 1880.)

METALS AND ORES.

	APRIL 29.		MAY 6.	
	£ s.	£ s.	£ s.	£ s.
COPPER (per ton)—				
Chili, for 96 per cent.	60 0/	—	57 0/	—
Wallaroo	76 0/	77 0/	76 0/	77 0/
Burra Burra	74 0/	76 0/	73 0/	—
English Tough	66 0/	—	64 0/	—
English Ingot best..	67 0/	—	67 0/	—
Sheets sheathing and rod ...	73 0/	74 0/	71 0/	—
Bottoms	79 0/	—	77 0/	—
Ore per unit	0 13/	0 13 6	0 13/	0 13 6
PHOSPHOR BRONZE				
Special Bearing Metal (p tn)	116 0/	—	116 0/	—
Other alloys (per ton	123 0/	139 0/	123 0/	139 0/
TIN (per ton)—				
Straits (Cash)	80 5/	—	80 5/	—
Do. for arr.	—	—	—	—
Billiton	—	—	—	—
Banca	—	—	—	—
English Ingots	85 0/	—	86 0/	—
Do. Bars	86 0/	—	87 0/	—
Do. Refined	88 0/	—	88 0/	—
Australian	80 5/	—	80 0/	—
TIN PLATES, per box, I.C. coke f.o.b. London	0 19/	0 21/	0 19/	0 21/
IX. do.	0 24/	0 26/	0 24/	0 26/
I.C. charcoal	0 21/	0 25/	0 21/	0 25/
I.X ,, ...	0 27/	0 31/	0 27/	0 31/
LEAD (per ton)—				
Soft English pig	16 10/	—	16 0/	16 5/
Do. W.B.	—	—	—	—
Spanish soft	16 5/	—	15 15/	—
Do. with silver	—	—	—	—
Sheet milled	17 0/	—	17 0/	—
Red lead	17 10/	—	17 10/	—
White	22 0/	—	22 0/	—
Patent shot	20 10/	—	19 10/	—
ZINC (per ton)—from No. 9 Gauge.				
Sheets, rolled	23 10/	—	23 10/	—
Do., foreign	24 0/	—	24 0/	—
SPELTER (per ton)—				
Silesian, com	20 0/	—	19 15/	—
Rhenish	—	—	—	—
English	—	—	—	—
QUICKSILVER, bot.	6 15/	—	6 12/6	—
ANTIMONY ore (per ton)—				
Australian	11 10/	14 10/	11 10/	14 10/
Spanish	—	—	—	—
French Star	69 0/	—	69 0/	—
Regulus—				
Crude (per cwt.)	1 14/	—	1 14/	—
NICKEL (per lb.)	0 3/6	—	0 3/6	—
BRASS (per lb.)—				
Sheets, 48×24.	0 0/8	—	0 0/8	—
Tubes	0 0/11	0 1/	0 0/11	0 1/
Wire	0 0/8½	—	0 0/8½	—
Yellow metal	0 0/6¼	0 0/6¾	0 0/6	0 0/6¼
ASBESTOS (per lb.)	0 0/3	0 0/6½	0 0/3	0 0/6½
PLUMBAGO (per ton)—				
Ceylon lump	0 17/6	—	0 17/6	—
Do. chip	0 10/6	—	0 10/6	—
Do. dust	8 6/	—	8 6/	—
COALS (per ton)—				
East Hartlepool	1 2/	—	1 2/	—
Lambton	1 4/	—	1 4/	—
Tees	1 4/	—	1 4/	—
Hartley	1 2/	—	1 2/	—
Hetton	1 4/	—	1 4/	—
Hawthorn	1 3/	—	1 3/	—
Tunstall	1 2/	—	1 2/	—

IRON.

	April 20. £ s.	£ s.	May 6. £ s.	£ s.
Iron, per ton (at works)*—				
Bars, Welsh, common	7 0/	—	7 0/	—
Do. Best	7 15/	8 5/	7 15/	8 5/
Scotch, Common	7 0/	7 10/	7 0/	7 10/
Do. Best	8 0/	8 10/	8 0/	8 10/
South Stafford, common	7 10/	8 0/	7 10/	8 0/
Do. Best	8 0/	9 0/	8 0/	9 0/
Sheets, singles, Cleveland	9 15/	10 0/	9 15/	10 0/
Staffordshire	10 0/	11 0/	10 0/	11 0/
Do. doubles, Staffordshire	11 10/	12 10/	11 10/	12 10/
Do. Lattens, Staffordshire	13 0/	14 0/	13 0/	14 0/
Plates, Ship, Stafford.	10 0/	10 10/	10 0/	10 10/
Do. Scotch	—	—	—	—
Do. Boiler, Stafford.	10 10/	11 10/	10 10/	11 10/
Hoops, Stafford	9 0/	9 10/	9 0/	9 10/
Nail Rods, Stafford	8 10/	9 0/	8 10/	9 0/
Swedish in Lond.	11 11/	12 0/	11 11/	12 0/
Angle Iron, Welsh	—	—	—	—
Do. Stafford	8 15/	9 10/	8 15/	9 10/
Pud. Bars, Welsh	—	—	—	—
Do. Stafford	6 10/	—	6 10/	—
Do. Scotch	—	—	—	—
Rails, Welsh	8 0/	8 10/	7 0/	7 10/
Do. Stafford	8 10/	9 10/	8 0/	8 10/
North England	5 5/	—	6 15/	7 10/
Light Rails, Welsh	8 5/	8 15/	7 5/	7 15/
Do. Stafford	8 15/	9 15/	8 5/	—
Pig Iron at Glasgow				
Scotch warrants	2 6 6	—	2 6 7	—
Do. No. 1	2 0/	3 0/	2 0/	3 0/
Cleveland, Tyne or Tees	2 10/	3 0/	2 7 6	—
Indian Charcoal, London	—	—	—	—
Wrought Iron Girders	18 0/	24 0/	18 0/	24 0/
Bolts and Nuts	18 0/	21 0/	18 0/	21 0/
Fish Bolts	18 0/	23 0/	18 0/	23 0/
Washers	18 10/	19 0/	18 10/	19 0/
Rivets	15 0/	18 0/	15 0/	18 0/
Spikes	17 10/	19 10/	17 10/	19 10/
Swedish Iron—				
f.o.b. Gottenburg, nett cash.				
Pig	—	—	—	—
Bar, rolled	11 10/	12 0/	11 10/	12 0/
Do. hammered	12 0/	12 10/	12 0/	12 10/
Billets	12 0/	—	12 0/	—
Horse Nail Rods	—	—	—	—
Belgian Iron—				
f.o.b. Antwerp, less 2½ per cent.	8 0/	—	8 0/	—
Bars and Slit Rods, common	Nominal			
Best				
Best Best				
Hammered				
Puddled Steel				
Bessemer				
Hoops				
Rails				
Rolled Girders				
Steel—				
Best cast	40 0/	42 0/	40 0/	42 0/
Do. dbl. shear	45 0/	—	45 0/	—
Do. single do.	38 0/	40 0/	38 0/	40 0/
English spring med. quality	14 0/	18 0/	14 0/	18 0/
Blister	21 0/	31 0/	21 0/	31 0/
Swedish keg	16 0/	—	16 0/	—
Milan	18 0/	19 0/	18 0/	19 0/
Bessemer rails	10 5/	10 10/	8 10/	9 0/
Scrap (per ton)—				
Old rails for remanufacture, D.H.	6 10/	—	4 0/	5 0/
Ditto flange or bridge	4 10/	6 0/	3 0/	4 0/
Engineers' scrap	3 0/	4 0/	2 10/	3 10/
Light scrap	3 0/	—	2 0/	2 10/
Scrap metal	2 10/	3 0/	1 10/	2 10/
Old steel scrap	3 15/	4 10/	3 0/	4 0/
Wire—				
Best best drawn killed gal. tel., Nos. 0 to 6	18 10/	—	18 10/	—
Do. 7 & 8	19 10/	—	19 10/	—
Do. 9	20 5/	—	20 5/	—
Do. 10	21 0/	—	21 0/	—
Do. 11	21 10/	—	21 10/	—
Do. 12	22 10/	—	22 10/	—
Rolled black fencing wire (per ton) 1 to 4	10 10/	—	11 10/	—
Do. 5	12 0/	—	12 0/	—
Do. 6	12 10/	—	12 10/	—
Do. 7	13 0/	—	13 0/	—
Bright Iron Wire (Charcoal wire, 4s. 6d. per bundle extra) per bundle of 63 lb. 0 to 6	0 14 6	—	0 14 6	—
Do. 7 to 8	0 15/	0 15 3	0 15/	0 15 3
Galvanised, 80s. per ton extra.				
Best best annealed drawn fencing wire, per ton 0 to 6	13 15/	—	13 15/	—
Do. 7	13 15/	—	13 15/	—
Do. 8	14 0/	—	14 0/	—
Castings (per ton) at works—				
Girders	6 10/	7 10/	6 10/	7 10/
Chairs	4 10/	5 0/	4 10/	5 0/ *
Floor plates	5 12/6	—	5 12/6	—
Pipes, 1½ to 2in.	6 12/6	7 0/	6 12/6	7 0/
Do. 3 „ 4	6 2/6	6 5/	6 2/6	6 5/
Do. 5 „ 8	6 1/6	6 4/	6 1/6	6 4/
Do. 10 „ 16	6 0/	6 2/6	6 0/	6 2/6
Do. 18 „ 24	5 17/6	6 0/	5 17/6	6 0/
Bolts and Nuts	17 10/	20 0/	17 10/	20 0/
Fish Bolts	18 10/	21 0/	18 10/	21 0/
Spikes	17 10/	18 10/	17 10/	18 10/
Rivets	14 10/	21 0/	14 10/	21 0/
Washers	19 10/	21 10/	19 10/	21 10/

* The entire ton consists of ten times 100 kilogrammes, or about 30 lb. short of an English ton.

OILS, CHEMICALS, &c.

	April 20. £ s.	£ s.	May 6. £ s.	£ s.
Oils (per ton)—				
Olive, Malaga	—	—	—	—
Do. Gioja	44 10/	—	44 10/	—
Do. Levant	42 0/	43 0/	42 0/	43 0/
Do. Mogador	—	—	—	—
Do. Tunis	—	—	—	—
Do. Seville	44 10/	45 0/	44 10/	45 0/
Do. Sicily	45 0/	46 0/	45 0/	46 0/
Seal, pale	29 0/	29 10/	29 0/	29 10/
Seal, yellow	27 0/	—	27 0/	—
Seal, brown	25 0/	—	25 0/	—
Sperm head	75 0/	—	75 0/	—
Cod	26 0/	26 10/	26 0/	26 10/
Whale, pale	26 10/	—	26 10/	—
Do. yellow	25 10/	—	25 10/	—
Do. brown	20 0/	—	20 0/	—
E.I. Fish	—	—	—	—
Rapeseed, English, pale	29 10/	—	29 10/	—
Do. brown	27 10/	—	27 10/	—
Foreign Pale	—	—	—	—
Ground nut and Gingelly Madr.	30 10/	31 0/	30 10/	31 0/
Palm oil, fine	31 0/	31 10/	31 0/	31 10/
Palm nut oil	32 10/	33 0/	32 10/	33 0/
Linseed oil	20 10/	20 15/	20 10/	20 15/
Cotton seed oil	26 10/	27 5/	26 10/	27 5/
Lard	42 0/	44 0/	42 0/	44 0/
Cocoanut, Cochin	35 0/	37 0/	35 0/	37 0/
Do. Ceylon	33 0/	—	32 10/	—
Mauritius	37 10/	—	37 10/	—
C. Price & Co.'s patent engine oil (per gal.)	0 3/6	—	0 3/6	—
Oil Cake (per ton)—				
Linseed, Lndn.	10 0/	11 0/	10 0/	11 0/
American bls.	10 2/6	10 5/	10 2/6	10 5/
Do. bags	9 2/6	9 5/	9 2/6	9 5/
Marseilles	9 5/	—	9 5/	—
Rape, English	5 0/	—	5 0/	—
Do. Foreign	—	—	—	—
Green Cotton	5 17 6	7 0/	5 17 6	7 0/
Tallow—PYC.	43 0/	—	42 0/	—
S. American. Beef	35 0/	—	35 0/	—
Do. Sheep	33 0/	34 0/	32 10/	33 0/
Australian Beef	32 0/	—	30 0/	32 5/
Do. Sheep	33 0/	34 0/	33 5/	34 0/
Rough Town Fat.	14 0/	—	14 0/	—
Petroleum—				
Fine (per gal.)	0 0/5½	—	0 0/5½	—
Do. spirit	0 0/7¼	—	0 0/7¾	—
Turpentine—Spirit—				
French	—	—	—	—
American casks	1 15/	—	1 15/	—
Whalefins (per. ton)—				
Davis' Straits	1000 0/	—	1003 0/	—
Arctic	950 0/	1000 0/	950 0/	1003 0/
Southern	500 0/	—	500 0/	—
Brimstone (per ton)—				
Rough, 2ds ind.	7 0/	—	7 0/	—
Do. 3rds, do	5 10/	—	5 10/	—
Roll	9 10/	10 5/	9 10/	10 5/
Sulphur, Flour (per cwt.)	0 12 0	0 12 6	8 15/	—
Acid, (per lb.)				
Acetic, fine	0 0/3	0 0/3 3-14	0 0/4	—
Do. common (per gal.)	0 1 5	0 1 6	0 1/5	0 1 6
Citric	0 2 9	—	0 2/8	—
Muriatic fine (per cwt.)	0 4/	0 7/	0 4/	0 6/
Do. common	0 4/	0 5/	0 4/	0 5/
Nitric	0 0/4½	—	0 0/4½	—
Oxalic (per lb.)	0 0/5	—	0 0/4½	—
Sulphuric, concentrated	0 0/1	—	0 0/1	—
Do. Brown	0 0/0¾	0 0/1	0 0/0¾	0 0/1
Tartaric Crystal	0 1 9	—	0 1/9½	—
Do. Pulv.	0 1/9	—	0 1/9½	—
Ammonia—				
Carbonate, per lb.	0 0/6½	0 0/6¾	0 0/6½	0 0/6¾
Sulphate, White & grey (per ton)	19 0/	—	18 10/	18 15/
Arsenic— White Lump (per ton)	23 10/	—	24 0/	—
Powdered, do.	11 0/	—	10 15/	—
Bleaching powder	0 8/6	—	0 7/6	—
Borax, Rfd., do.	3 5/	—	3 1/	—
Copperas (ton)	2 15/	3 5/	2 10/	—
Bi-Sulphide Carbon (per ton)	24 10/	26 0/	24 10/	26 0/
Portland Cement—				
1st quality, in cks 400 lb. gross, inc. csks., f.o.b., Thames, per csk.	0 9/	—	0 9/	—
Do. in sks, 200 lb. net (per ton)	2 0/	—	2 0/	—
Sacks extra, 1/6 each.				
Charlton White Paint (per cwt.)	1 12/	—	1 12/	—
Calley's Torbay Paint, Brown	0 30/	—	0 30/	—
Do. Red	0 34/	—	0 34/	—
Hypophosphites (per lb.)—				
Iron	0 9/3	0 10/	0 9/3	0 10/
Lime	0 5/3	0 7/	0 5/3	0 7/
Magnesia	0 9/	0 9/	0 9/	0 9/
Manganese	0 9/	0 9/	0 9/	0 9/
Soda	0 5/3	0 6/	0 5/3	0 6/
Lead (per cwt.)—				
Acetate, best	2 0/	—	2 0/	—
Nitrate	1 15/	—	1 15/	—
Red (per cwt.)	0 23/	—	0 18/	—
White	1 4/	—	1 2/	—
Litharge (pr cwt.)	1 1/	—	0 18 6	—
Lime (per ton)—				
Acetate, Grey, 85 %	21 0/	—	21 0/	—
Do. Brown 70%	14 0/	—	14 0/	—
Potash—				
Bichromate (lb.)	0 0/6¾	0 0 7	0 0 6¾	—
Chlorate (pr. lb.)	0 0 7¾	—	0 0/7¾	—
Muriate, 80% ton	6 15/	—	6 15/	—
Pruss. Red (lb.)	0 1/8	0 1/10½	0 1/11	—
Do. Yel. lb.	0 0/11¼	0 1/	0 0/11¼	0 /11½
Sulphate, 80% (per ton)	9 0/	10 0/	14 0/	16 0/
Saltpetre (per cwt.)—				
Engl. refnd. kgs.	1 8 3	—	1 8 3	—
Do. barrels	1 6/	—	1 7 3	—
Do. Bengal	0 19 6	1 1/6	0 19/0	1 1/6
Soda—				
Ash ... deg.	0 0/1 15-16	0 2/	0 0/1 15-16	0 2/
Bicarb. (per cwt.)	0 12/	—	0 10/9	—
Caustic, 60 % to 72%	0 12/	0 12 6	0 11/	0 13/
Nitrate (per cwt.)	17 0/	—	0 16/	0 16 6
Crystals (per ton)	3 15/	—	3 12/6	—

* Per ton extra in London, Staffordshire, 15s.; Scotch, 10s.; Lancashire, 15s.; Welsh, 10s.

PARTNERSHIPS DISSOLVED.

Arthington and Fletcher, Huddersfield, brassfounders.—Jackson and Longley, Bradford, architects.—Skelding and Barklam, Yardley, Worcestershire, brick manufacturers.—A. C. Wylie and Co., Cannon Street, City, engineers.—Gibson, Taylor, and Winnard, Parbold, Lancashire, quarrymen; as far as regards J. Gibson.—Brearley Brothers, Otley, Yorkshire, engineers.—E. Adams and Co., Longton, manufacturers of majolica; as far as regards E. Adams.—W. Macfarlane and Co., Glasgow, ironfounders; as far as regards J. Marshal and T. Russell.—J. W. Robinson and Co., or Wright and Mawdesley, Liverpool and Southport, manufacturing and selling implements for planting potatoes and potato diggers, &c.—H. Tipping and Co., Portsmouth, engineers; as far as regards J. Q. Swayne.—Waring Brothers, Victoria Chambers, Westminster, contractors for public works; so far as regards W. and H. Waring.—G. Fowler and Co., Beech Street, Barbican, wholesale ironmongers.—Swan Iron Company, Dalston, ironmongers; F. and J. Levy Manchester, tailors.—Ridge, Woodcock and Hardy, Sheffield, electro plate manufacturers.

PRICES CURRENT OF MANUFACTURED GOODS

OF

BIRMINGHAM AND DISTRICT.

⁂ This List being compiled exclusively for the pages of Iron, all rights of reproduction are reserved.

The quotations given are merchants' and factors' average prices, dependent, of course, on terms of payment as well as the quality and quantity of goods ordered, and fluctuations in cost of raw material.

The Prices and Discounts quoted are carefully revised every week, and great pains are taken to render this List thoroughly reliable.

May 6th, 1880.

There is for the present a check in the downward course of heavy hardware, and those items which we have noticed as reduced have not further receded. We have, however, to add to them reductions in cast nails (slate and wall), common sadirons, and box iron heaters which have now been reduced 10s. per ton, and flat weights, bar ring and bell weights have been increased in discount 2½ per cent. equal to nearly 5 per cent. on the nett. Light hardware has fluctuated only slightly, and the only alterations we have to announce is in brass toddy kettles, which in consequence of the fall in brass and copper, are reduced 2½ per cent. in discount; house bells from the same cause are further reduced ¼ to ½ per pound on the reduction of the 23rd of April. Pewter goods stand now lower than last week the discounts on ale and wine, measures being increased 2½ per cent., and are now quoted from 35 per cent. to 40 per cent. German nails or Paris pointes on the whole are easier, and makers are sending out reduced quotations. Most of the brass founders have now brought their discounts on a level, and as a rule 2½ per cent. more is now quoted than was the case a month ago. In tin no further reduction has taken place, but the market is very unsettled.

ABRIDGED LIST.

Axles, 15 to 25%; coach ironwork, 10 to 15%; coach and waggon springs, 15 to 20%; Augers, 10 to 20%. **Axes.**—Ship carpenters', /5½ to /6 per lb.; Kent and house carpenters', /5 to /6; ditto, steel polished, /5½ to /7; felling axes, /4¼ to /4¾; polished, /4½ to /6; bright and blued solid steel, /7 to /8; American felling or wedge Axes, steel polished, 1/ to 1/4 per lb.; common **Anvils**, 84 lb. and upwards, 18/6 to 20/ per cwt.; best warranted, 22/ to 24/; ditto, and ends warranted not to break off, 27/ to 35/.

Door springs, X, 75 to 80%; **XX**, 70 to 72½%; **XXX**, 65 to 67½%; XXXX, 55 to 60%; brass circular and iron circular, 55 to 60%; brass reliance, 10 to 15%; climax, 5 to 10%; universal, 50 to 60%; paragon, 10 to 15%; smiths', 10 to 15%; O'Connor's patent lever hinge springs, 10 to 15%; O'Connor's vertical spring hinge door spring, 15 to 25%; Gerish's spring hinges, iron, 20 to 25%; brass, 10 to 15%; japanned **Door chains**, 30 to 60%.

Files, 25 to 50%; **Frying pans**, best, 47½ to 52½% common, 55 to 62½%; kitchen **Fireirons**, in sets, /6 to /7 per lb.; tongs only, /6½ to /7; pokers only, /5¾ to /6 per lb. **Fish hooks**, 30 to 35%, best; common, 50 to 55%; light kitchen **Fenders**, 5 inch assorted, 2 feet 6 inches to 3 feet 6 inches, black fronts, 28/ to 29/ per doz.; bright fronts, 31/6 to 34/; Manchester pattern kitchen Fenders, 5 feet 1 inch top, black front, 2 feet 9 inches to 3 feet 3 inches, 37/6 to 41/ per doz.; 3 feet 3 inches to 3 feet 9 inches, 42/6 to 46/. Cut wire **Fencing staples**, 0 to 6, 22/ to 24/ per cwt.

Gridirons, London pattern, fluted, 62½ to 65%; light ditto, 61½ to 67½%; hanging round bar, 50% to 55%; doublet, 37½ to 42½%; round bar /1½ per bar, 57½ to 62½%; best fluted bar, 55 to 62½%; flat bar, 57½ to 62½%; common flat bar, 57½ to 62½%; common Gridirons, /1, /1½ and /2 per bar, 65 to 70%; **Goffering tongs**, two prongs, 5/6 to 6/6 per doz.; **Gimblets**, 10 to 15%.

Ironfoundry, general.—Ash grates, 11/ to 12/, air bricks, 2/9 to 3/6, half, single, 3/6 to 4/3, double, 6/3 to 7/; bars and bearers, 9/6 to 10/6 per cwt.; barrow wheels, 10/6 to 11/6; bake pans, 9/6 to 10/6; cart bushes, 11/6 to 13/6; camp ovens, 10/ to 11/; cooking stoves, 12/6 to 13/6; cogs for blocks, 17/ to 19/; cellar grating, 10/6 to 12/6; clock weights, 9/ to 11/; Dutch stoves, 11/ to 13/; dumb bells, common, 9/ to 11/; best best japanned, 19/ to 21/; frying pans, cast handles, 12/6 to 14/6; frying pans with wrought handles, 16/ to 18/; furnaces, up to fifty gallons, /3½ to /4; galvanised furnaces up to fifty gallons, /9 to 1/ per gallon; furnace doors, 12/ to 14/; furnace grates, 9/6 to 11/6; forge backs, 12/6 to 13/6; heaters for box irons, 8/6 to 10/6; heaters for urns, 10/ to 11/; jack wheels, 18/ to 20/; oven doors and frames, 12/ to 14/; pots, three legged, Danish, plumbers', and Nego, 10/ to 12/; plumb bobs, 13/6 to 15/6; pudding pans, 13/6 to 15/; pump spouts, 14/ to 16/; sash weights, 8/6 to 9/6 ditto, with pulleys, 11/ to 13/; shoe anvils, 11/6 to 12/6; slippers 12/6 to 13/6; **Italian irons**, 35 to 50%.

Knitting pins, iron, /4½ to /5 per lb.; steel knitting pins, 15 to 24 W.G., 1/ to 2/6 per lb.; brass knitting pins, 1/4 to 1/6 per lb.; **keys and banks**, 50 to 55%; extra strong plate, 30 to 32½%; extra strong Banbury, pin'd keys, 30 to 35%; brass shutter **knobs**, 55 to 60%; brass cupboard turns, 55 to 60%; brass drawer knobs, 53 to 60%; brass ash pan knobs, 55 to 60%; brass range knobs, 40 to 45%; **kettle ears**, 77½% to 80.

Lock furniture, brass, 60 to 65%; buffalo, 25 to 30%; china lock furniture, 37½ to 42½%; ebony lock furniture, 2¾-inch, Wilkes' spindles, 15/ to 18/ per dozen sets; sham ditto, 8/ to 9/ per dozen sets; **Norfolk latches**, common, best, 65 to 77½% common. **Suffolk latches**, 70 to 72½%; best Suffolk latches, 45 to 55%; tinned struck **ladle bowls**, 4-inch, 15/6 to 16/6; 4½-inch, 18/6 to 20/; 5-inch 23/ to 25/ per gross net.

Oddwork, tinned and black, 20 to 25%, list; **Paris pointes** best English, 15/6 to 16/; foreign, 18/ to 20/; **planes**, 25 to 30%; iron **axle pulleys**, 1¾ inch, 12/6 to 18/; brass face axle pulleys, 28/ to 40/ per gross; B. F. and wheel, 48/ to 60/ per gross; brass escutcheon pins, ⅝ inch to 16 W. G., 1/ to 1/2 per lb.; bright gimp pins, ⅝ to 10 W. G., /6 to /8 per lb.; black, /7 to /9; brass 1/6 to 1/8 per lb. Japanned cut **gimp pins**, ⅝ inch, /7 to /8 per lb.; tinned, /8 to /9 per lb.; cut clog or coffin pins, japanned, ⅝ inch, /5 to /6; tinned, /7 to /8; brass pin pointes, 1/4 to 1/6; **plate locks**, fine 50 to 52½%; strong, 40 to 42½%; Lancashire plate locks, 25 to 30%; pewter measures, 30 to 35%.

Riddles, 30 to 35%; **Rivets**, iron boot rivets, /3½ to /4 per lb. patent machine-made Rivets, 30 to 35%; wrought tinmen's Rivets, 50 to 55%; round or panhead boiler Rivets, ¼ inch, 23/ to 24/; ⅜ inch, 18/ to 19/; ½ inch, 17/ to 18/; ¾ inch, 16/ to 17/. Delivered in London or Liverpool; machine-made wire Rivets, ⅜ inch, 14/6 to 15/6 per cwt. **Rakes**, light garden Rakes 50 to 60%; light solid end Rakes, 47½ to 50%; bolstered teeth garden Rakes, 50%; solid end bolstered teeth garden Rakes, 40 to 45%.

Traps, bow spring, sham Dorset and real Dorset rabbit traps, 45 to 65%, list prices; common traps, 4 inch, 5/6 to 8/ per doz. net; run traps, 2½ inch, 4/ to 8/6 per doz.; bird traps, 3/9 to 4/ per doz.; wolf and other double flat spring, common bridge, 1/; axle bridge, 1/4 per lb., 40 to 45%; hawk or pole traps, 54 to 60%; wrought mole traps, japanned, 2/6 to 3/9; galvanised, 3/9 to 4/9. **Tin plates**, I. C., 30/ to 32/. **Tinmen's machines** and tools, 5%; brass **Bell Tube**, ⅝ inch and upwards, 1/ to 1/1 per lb.; copper bell Tube, 1/2 to 1/4 per lb.; zinc bell Tube, 45 to 50% list; **Patent cased Tube**, 45 to 50%; cut to lengths, 40 to 45%; burnished and lacquered brass tube, 30 to 35%; polished and lacquered twisted brass tube, 30 to 35%; patent taper iron tube, 30 to 35%; patent cased taper iron tube, 30 to 35%; parallel iron brased tube, 30 to 35%; twisted iron parallel tube, 30 to 35%; patent cased twisted iron parallel tube, 30 to 35%; iron **Gas Tubes**, 70 to 72½%; fittings, 72½ to 75%; iron **Water Tubes**, 60 to 65%; fittings, 62½ to 67½%; iron **Steam Tubes**, 62½ to 65%; fittings, 65 to 67½%; galvanised iron gas Tubes, 57½ to 60%; fittings, 60 to 65%; lap-welded **Boiler Tubes**, 60 to 62½%, delivered in London, Liverpool or Glasgow; table catches, 36 to 40%; ditto, improved brass follow, 20 to 25%; wrought japanned **Tea kettles**, 50 to 60%; galvanised **Turnip skips**, 21 inches, light, 25/ to 26/ per doz.

Vices, common black, 32/ to 34/ per cwt.; common bright, 40/ to 42/ per cwt.; black staples vices, solid box black, 42 to 48/; bright, 41/ to 47/; solid box, black staple, with spherical washer, 40/ to 45/; bright 41/ to 55/.

Washers, light iron, 72½%; heavy washers, 13 to 16 lb., W.G., 12/ to 12/6 per cwt.; ¼ inch thick, 2/ per cwt. extra; 5-16 inch, 3/; ⅜ inch 4/; shook bright washers, 3/ to 3/6 per cwt. extra; **Wall hooks**, 23/ to 25/ per cwt.; **Washing tubs**, galvansed oval, 22 inch, 19/ to 30/; 24 inch, 34/ to 35/; round, 22 inch, 38/ to 40/; **Water bowls**, hammered, list price, 52½ to 57½%; light seamed 9 inch, 8/ per dozen; light wired 9 inch, stamped, 11/ to 12/; **Wove wire** list price, iron, copper and brass, 45 to 50%; iron **Wire**, bright, 0 to 6, 14/6 to 15/6 per cwt.; galvanised, 18/6 to 19/6; fine galvanised iron wire, No. 23, 5/3 to 5/6 per stone 14 lb.; annealed tinned wire No. 18, 4/ to 4/3 per stone 14 lb.; cut tinned bottling wire, No. 22, 4/11 to 5/6 per stone 14 lb.; weaving and binding wire, No. 23, 3/ to 4/2 per stone 14 lb.; bright or annealed fine wire, 23, 5/7 to 5/9 per stone 14 lb. net; cast steel wire, 0 to 6, /6½ per lb.; 10 to 20%; metallic or horticultural wire, 6 to 14, /5½ to /6½ per lb; No. 15, 5¾ to /6; 16 to 20, /5½ to /6½; in 1 lb. rings, 1¼ inch diameter, ¼ per lb. extra; prepared bright **fencing Wire**, 0 to 6, 14/6 to 15/ per cwt.; annealed drawn fencing wire, 0 to 6, 13/3 to 14/3; annealed drawn galvanised, 0 to 6, 17/6 to 18/6. Bright or annealed steel, 0 to 6, round or oval 16/9 to 17/9 per cwt.; black rolled, 1 to 4, 11/6 to 12/6 per cwt.; galvanised rolled, 1 to 4, 14/9 to 15/9 per cwt.

H. AUGUSTUS GUY AND COMPANY,

Government Contractors and Medallists,

MANUFACTURERS OF

BAR STEEL FOR TURNING TOOLS, SCREW TAPS AND DIES, DRILLS, CHISELS, PUNCHES, SNAPS, &c.;

ALSO

Double and Single Shear Steel, Spring and Sheet Steel, Cotter, Key, and Ferrule Steel, &c.

BESSEMER AND CRUCIBLE STEEL FORGINGS AND CASTINGS OF EVERY WEIGHT AND SECTION.

SOLE PROPRIETORS AND MANUFACTURERS OF

GUY'S "INVINCIBLE," "RELIABLE," AND "MINING" TOOL STEEL.

The unequalled excellence and undeviating uniformity of these famous Brands secure an immense economy in the workshop and the mine.

EXTRACTS FROM THE SCIENTIFIC JOURNALS OF 1876.

From the "MINING WORLD."—The inventor meets the difficulties so long experienced in the shops of the engineer at home and abroad. The "Invincible" Tool Steel is the best and cheapest ever yet discovered.

From the "COLLIERY GUARDIAN."—The "Invincible" Tool Steel is especially adapted to the manufacture of Turning Tools, Chisels, Dies, Punches, &c. It produces a tool which will outlive three or four ordinary tools. The matter will become one of the greatest importance to all engineers.

From the "MINING JOURNAL."—A superior quality of Tool Steel is now being introduced, distinguished by the brand "Invincible." The formidable item which figures in every engineer's prime cost book for "making and repairing of tools," sufficiently explains the reason for the introduction of this steel.

From the "IRON AND COAL TRADES REVIEW."—It is highly satisactory to find a practical firm of such high reputation as Messrs. GUY AND COMPANY devoting their attention to the production of an article which shall fulfil the many conditions required in a first-class Tool Steel. In all trials the "Invincible" has been eminently successful, and we feel that it is a matter for congratulation that an article which wields such potent influence over the prosperity of the workshop has been so much improved.

From the "IRON TRADE CIRCULAR" (Ryland's).—In the leading article on the Quarterly Meeting at Birmingham of the South Staffordshire Iron and Associated Trades, the Editor says, "We ourselves showed a fine sample to many of the Sheffield people in the Hall, also to the Birmingham Manufacturers of Edge Tools, who at once pronounced it to be of high quality. Perfectly homogeneous in the grain, of great durability, and requiring no scientific manipulation for practical use, it will obviate the complaints frequently heard against the steel now made."

From the Industrial Article of the "RECORDER."—The Mechanical and Mining Engineer has long complained that one of the most vexatious sources of difficulty and disappointment arose from the ever varying and insufficient Tool Steel which came to hand. The "Invincible" Tool Steel has been examined very closely and submitted to severe test. The lasting power of the die, drill, or chisel is the end which the inventor has in view. Although at the outset necessarily costing more than the so-called ordinary Tool Steel, it is by far the cheapest in the end; there can be no doubt that the "Invincible" Tool Steel will at once take a very high position in the engineering and mining centres of this and foreign countries.

From the "GLASGOW ENGINEER AND IRON TRADE ADVERTISER."—A new and valuable Steel, designed chiefly for Chisels, Dies, Drills, and general turning, has been recently brought out by a firm whose high reputation for practical skill sufficiently guarantees the preference which will doubtless be accorded to it. The proprietors of this useful article very appropriately call it the "Invincible" Tool Steel. A sample forwarded to us was subjected to the most trying tests, with results of the highest order. It is, perhaps, not too much to say that this Steel will meet the difficulties so long felt in the shops of the engineer.

From "IRON."—IMPORTANT DISCOVERY IN THE STEEL MANUFACTURE.—Mr. H. AUGUSTUS GUY has, under the title "Invincible," introduced a new variety of Steel, which has been found peculiarly fitted for the manufacture of Turning Tools, in which a high degree of toughness and hardness is essential. Great saving must follow from the lasting quality of this material. Those firms who use Steel will find the "Invincible" by far the most economical yet discovered. The Steel, as now made, is worthy of its high claims, and substantially deserves the "Invincibility" indicated by its name.

From the "LONDON IRON TRADE EXCHANGE."—We have been supplied with a specimen of the "Invincible" Tool Steel. This Steel is very homogeneous, particularly fine in the grain, and we should judge the specimen to be a very high class of Steel.

GUY'S IMPROVED "MINING" TOOL STEEL.

The difficulties hitherto attending the production of a Mining Tool Steel of undeviating homogeneity, and adapted to the general requirements of the miner, have been effectually overcome in this new Steel, which is especially prepared for hand and power Rock Drills, Hammers, Picks, &c. It embodies the essential conditions of uniform hardness and toughness, so difficult of attainment, and so palpably wanting in Mining Steel generally, while its medium price will be fully appreciated.

The following practical testimony of the "**EAST POOL MINE**" places its merits beyond question:—

"**EAST POOL MINE, CORNWALL,**" 16th October, 1879.

"We are very pleased to say that the Steel sent us from Messrs. H. AUGUSTUS GUY AND COMPANY has more than answered our expectations; and after a lengthened and exhaustive trial (with five separate deliveries of about half a ton each, between April last and the present time), are quite convinced it is the best "Mining" Steel we have used, and do not hesitate to recommend it to Mining Companies requiring a reliable and trustworthy article. We may state that we not only use it for Hand Borers, but also for the Eclipse Rock Drill, with very great success.

(Signed) "JOHN MAYNARD.
"CHAS. BISHOP."

This Steel was awarded the highest prize at the Exhibition of the Mining Institute of Cornwall, in November, 1879; while in the Competitive Trials of the leading Rock Drills, on the 30th of the same month, those using our Mining Steel for Boring Bits eclipsed all others.

LIBERAL TERMS FOR MERCHANT SHIPPERS AND THE TRADE.

Chief Offices: 11, CLOAK LANE, CANNON STREET, LONDON, E.C.

INVINCIBLE STEEL WORKS: SHEFFIELD.

BUSINESS CARDS.

CHILD BROTHERS
Falcon Works.
SMETHWICK NEAR BIRMINGHAM,
Manufacturers of all kinds of Engineers', Machinists', Carriage and Coach
BOLTS AND NUTS;
Set Screws: Patent Pointed Coach Screws; Patent Boiler Ship, Tank and Girder Rivets, Anvils, Vices, Washers, &c.
TRADE · C · B · MARK
REGISTERED.
GENERAL SMITHS.

S. MOULTON & CO.,
KINGSTON INDIA-RUBBER MILLS,
BRADFORD, WILTSHIRE.

Manufacturers of their Patent Steel Embedded and other India-rubber Springs for Locomotives, Railway Carriages and Trucks, India-Rubber Valves, Sheet Packing, Washer Rings, Hose Pipes, and Tubing, Machine Banding, Waterproof Garments, Blankets Sheeting, Elastic Hot Water Beds, Cushions, Patent "Moss" Inking Rollers for Printers, Truss Pads, and Umbilical Cones, &c.&c.

ECONOMY.

"If you have an efficient automatic cut-off valve and an automatic steam-tight piston, you are bound to have an economical engine."—Science Lectures.

No more Throttle Valves. No more Leaky Pistons. No Addition to Prime Cost.

For full particulars of the "Turnbull" Cut-off Valve Gear and the Double-action Piston Packing, apply to

JOHN TURNBULL, JUN.,
Consulting Engineer, 184, Buchanan-street, Glasgow.

NO MORE INCRUSTATION
BY USING THE
Globe Steam Boiler Powder.

For Testimonials and Particulars, apply to
J. BERGER SPENCE & CO.,
31, LOMBARD STREET, LONDON, E.C.

THOS. B. CUMPSTON and CO.,
BANK STREET, LEEDS,
MANUFACTURERS OF
ROOFING FOR SHEDS. &c.,
(Entirely superseding the Felt Roofing).
Tarpaulin and Railway Waggon Covers

SUTTON AND ASH,
IRON AND STEEL MERCHANTS,
BIRMINGHAM.

LARGE STOCKS of all descriptions of ROLLED IRON, including the most noted South Stafford brands.

Bars, Angles, Tees, Channels, Girder, Hoops, Sheets, Boiler, Ship and Tank Plates, Fencing Wire, Galvanised Sheets, Galvanised and Corrugated Sheets, Bessemer and Siemens Steel.

ANDREW WILSON,
STAMPER OF ALL KINDS OF
IRON AND STEEL WORK.
Iron and Steel Stamping Works,
276, BROAD STREET,
BIRMINGHAM.

THE LANGLEY MILL
Engineering Wheel & Wagon Co. Limited,
Railway Wagon Builders & Repairers,

MILLWRIGHTS, IRON AND BRASS FOUNDERS, Manufacturers of Solid Wrought-iron Locomotive Engine, Carriage and Wagon WHEELS, CRANKS, AXLES, SHAFTS, and every description of SMITHS' WORK, PIT CAGES.

METAL TUBBING,
ALL KINDS OF COLLIERY CASTINGS, AND EVERY VARIETY OF
CRUCIBLE STEEL CASTINGS.
LANGLEY MILL, near NOTTINGHAM.

ANDREW AND JAMES STEWART,
OFFICES: 41, OSWALD STREET, GLASGOW.
CLYDE TUBE WORKS, GLASGOW AND COATBRIDGE.
MANUFACTURERS OF
LAP-WELDED IRON BOILER TUBES.
As supplied to the English, French, and Dutch Admiralties, and the principal Railways and Engineers at home and abroad.
WROUGHT IRON WELDED TUBES AND FITTINGS,
Borings and Artesian Tubes, Perkins' Hot Water Tubes, Tubes closed at one end for Field Boilers, and all other descriptions of Tubing.
LOCOMOTIVE IRON AND STEEL TUBES
OF VERY SUPERIOR QUALITY.
PRICES ON APPLICATION. CAST IRON PIPES.

THE CLYDE RIVET WORKS CO., GLASGOW.

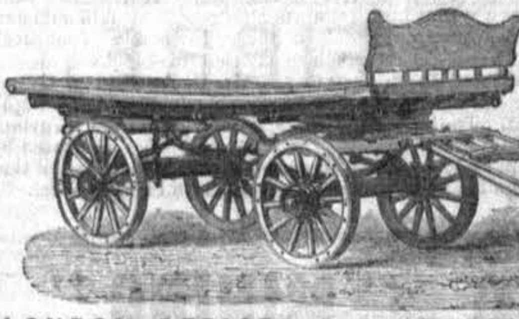
Ship-Boiler Girder Rivets, Railway Spikes, Screws, Screw Bolts, Nuts,
BEST MATERIALS AND WORKMANSHIP. MODERATE PRICES.
PROMPT DELIVERIES OF ALL HOME AND EXPORT ORDERS.

B. M. RENTON,
Iron and Steel Merchant, Savile Street, Sheffield,
HAS ALWAYS A LARGE STOCK OF
BESSEMER RAIL ENDS
AND
OLD BESSEMER DH RAILS

For Sale in all parts of the country, also Bessemer Billets and Blooms of any size and for all purposes, Old Steel Tyres either whole or broken, Old Springs, Old Files, Cut Bessemer Scrap and Spring Ends for remelting, English and German Spiegeleisen, Swedish and Russian Steel Iron and Box Ends, Swedish Nail Rods and Bundling Iron.

THE LONDON PORTLAND CEMENT COMPANY (LIMITED),
NORTHFLEET, KENT.
Chief Office—123, BISHOPSGATE STREET, WITHIN.
MANUFACTURE CEMENT WITH SPECIAL REFERENCE TO ITS DESTINATION, WHETHER FOR HYDRAULIC WORKS UNDER GUARANTEED TEST, or for PLASTERERS' and GENERAL PURPOSES.

THE BRISTOL WAGON WORKS COMPANY,
LIMITED,
LAWRENCE HILL, BRISTOL.
MAKERS OF
CARTS, WAGONS, TROLLIES, DRAYS, &c.,
OF ALL DESCRIPTIONS.



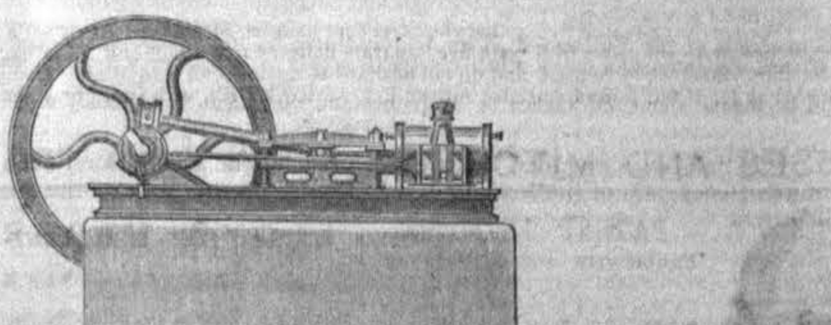
CART and WAGON WHEELS in Wood and also in Wrought Iron for Hot Climates.

FULL CATALOGUE (the largest and most comprehensive in the trade) FREE ON APPLICATION.

Also Makers of Railway Rolling Stock and Tram Cars.

LONDON OFFICES—8, VICTORIA CHAMBERS, WESTMINSTER, S.W.

THE GAS ENGINE.



NO SMELL—NO MORE NOISE THAN WITH A STEAM ENGINE.

For Prospectuses, Testimonials, &c., apply to
H. S. CROPPER & CO, MINERVA WORKS, GREAT ALFRED ST., NOTTINGHAM.

THE SILICATE PAINT COMPANY,
(Proprietors, J. B. ORR & CO.),
MANUFACTURERS OF
NON-POISONOUS PAINTS FOR ALL PURPOSES,
INCLUDING
"CHARLTON WHITE," A Complete Substitute for all White Pigments Hitherto in Use.
SILICATE OIL PAINT and CHARLTON ENAMEL PAINT,
UNEQUALLED AS PRESERVATIVES OF
EXPOSED IRONWORK OF EVERY DESCRIPTION.
AND EXTENSIVELY USED AT HOME AND ABROAD ON
Girders, Bridges, Iron Ships, Railway and Mining Plant, &c., &c.
QUALITY GUARANTEED. 5 CWT. CARRIAGE FREE.
Marine Paints, Varnishes, Japans, Oil and all Painting Requisites.
FULL PARTICULARS ON APPLICATION TO THE OFFICES OF THE COMPANY,
LONDON, LIVERPOOL, AND GLASGOW.
Chief Office and Works, CHARLTON, LONDON, S.E.

THE LANDORE-SIEMENS STEEL CO., LIMITED
DIPLOMA OF HONOUR, VIENNA, 1873. TRADE L S S C MARK GOLD MEDAL, PARIS, 1878.
Contractors to the Admiralty, British and Foreign Governments.
MANUFACTURERS OF
STEEL PLATES FOR SHIPS, BOILERS,
AND GENERAL WORK.
SHEETS, ANGLES, TEES, BULB BEAMS of all Sections. "S. S." Brand, Special Quality for BOILER-FURNACES, TUBE-PLATES, &c. AXLES, TYRES, FORGINGS, CASTINGS,
Weldless Angle and Flat Rings for Boilers, Weldless Dredger Bucket Mouths, Ingots, Blooms, Billets, Bars, Wire Rods, &c.
D. CAMPBELL, (Sole Representative),
3, WESTMINSTER CHAMBERS, VICTORIA STREET, LONDON, S.W.

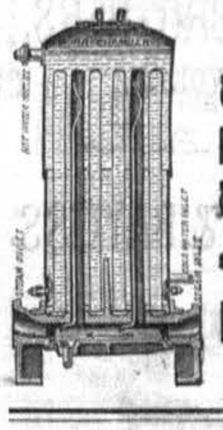
VULCANISED FIBRE,
PATENTED.

The FLEXIBLE is a Substitute for Leather, Rubber, Gutta Percha, &c., and is extensively used by Plumbers, Brass Founders, Axle Makers, Hydraulic, Sanitary, and other Engineers, Railway Companies, Carriage Builders, Pump Makers, &c.
It makes the best insertion sheet, and for axle-washers of all kinds it is unequalled.
Mr. George Howe, Engineer at the Clay Cross Collieries, says:—
"That a pump clack faced with Vulcanised Fibre one half inch thick, was put into work January 13th, 1879, and was taken out July 3rd, 1879, having been in work 171 days. During this time the pump made 741,827 strokes, and raised 74,182,700 gallons. The clacks were previously used with leather facings; these only lasted in work about 40 days; when faced with gutta percha, they last in work about 150 days, but gutta percha is 5s. per lb., whereas the fibre is only 2s."
The HARD is a Substitute for Metals, Ivory, Vulcanite, Ebony, &c., and is used for Journal Bearings and Bushes, Condenser Ferrules, Railway Fish-plate Washers, Pneumatic Carriers, Electric Machines, &c.
Mr. T. A. Edison, the great electrician, writes:—
"I esteem it very highly, and use larger quantities of it than Vulcanised Rubber, and, in its present condition, find it very satisfactory."
Both qualities of the Vulcanised Fibre are uninjured by the action of Hot and Cold water, oils spirits, grease, ammonia, and many other chemical agents which utterly destroy leather, metals and rubber.
Sold in sheets about 66 inches by 42 inches and varying in thickness from 1-32 to 1 inch.
SOLE AGENTS:—
MOSSES AND MITCHELL, 62, Queen Victoria Street, London, E.C.

PATENT INJECTOR.
Fanblowers and Exhausters,
ALL SIZES IN STOCK.
To blow from 3 to 100 Smiths' Fires, and to melt from 8 cwt. to 10 tons Metal per hour.
J. Donald & Son,
42 CADOGAN STREET, GLASGOW.

LLOYD HARGREAVES,
GENERAL PATTERN MAKER.
Maker of all kinds of SPUR, BEVIL, SKEW and ECCENTRIC GEARING.
GAOL LANE, HALIFAX.

ATKINSON'S



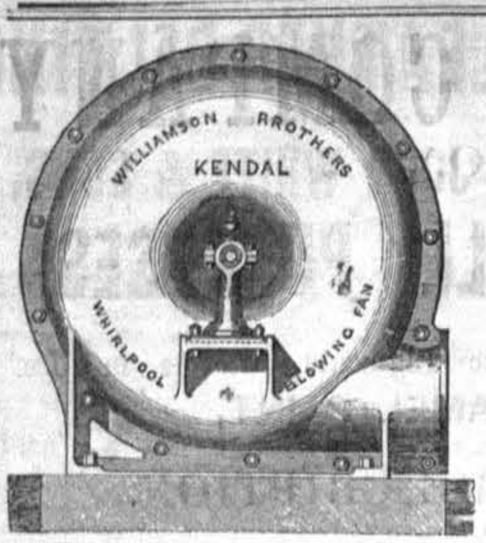
FACTS.
PATENT
FEED-WATER HEATER,
THE MOST EFFICIENT,
CHEAPEST.
EASIEST TO CLEAN.
NO BACK PRESSURE.
TUBES SCREWED IN, and FREE TO EXPAND.
NO GREASE IN BOILER.
WATER PURIFIED, and PUMPED WHILST COLD.
MOST DURABLE.
Illustrated Circular, Particulars and Prices apply to
JAMES ATKINSON,
47, Marquis Road, Finsbury Park,
LONDON, N.

BUSINESS CARDS.

PULFORD'S MAGNETIC PAINT.
MANUFACTURED FROM IRON,
Ready for the brush in cans, 7 lb., 14 lb. 28 lb., 56s. per cwt.—all colours. The can forms a paint pot with handle, no extra charge. Most suitable for Gas Holders, Iron Bridges, Railway Waggons, &c., and for all IRON, WOOD AND STONE WORK.
A Sample Can at Depot, 7 lb., 3s. 6d.
77, CANNON STREET, CITY E.C.,
Between Cannon Street, and Mansion House Stations.
Most suitable for all Garden purposes. Established 1858.

ASBESTOS
FINE SPUN YARN AND PLAITED ROPE AS SUPPLIED TO THE ADMIRALTY FOR STEAM PACKING.
MILLBOARD, IN SHEETS,
Or Cut to Shape for Steam Joints,
AND FOR GAS ENGINES,
Bell's Patent Asbestos Boiler and Pipe Covering for Preventing the Radiation of Heat.
All Asbestos Goods of the best quality manufactured by
JOHN BELL,
118, SOUTHWARK STREET, S.E.

THE GARNKIRK FIRE CLAY CO.
GARNKIRK WORKS, NEAR GLASGOW,
OFFICE: 243, BUCHANAN STREET, GLASGOW.
Manufacturers of
FIRE BRICKS and BLOCKS for the highest heats for Iron blast-furnaces, forge, rolling, puddling and steel furnaces, pottery, bottle and flint glass furnaces, copper, calcining, roasting, and refining furnaces, chemical works, coke ovens, boiler seat blocks, locomotive bricks, &c.
Special Bricks made for Siemens' Patent Regenerative Gas Furnace. Registered Trade Mark, "GARNKIRK."



BLOWING FANS,

FOR CUPOLAS OR SMITHS' WORK.

These Fans are strong, well made, and require the least power to give any required blast.

CENTRIFUGAL PUMPS,

VORTEX TURBINES,

The best means of utilising water-power.

STEAM ENGINES, CORN MILL MACHINERY,

Illustrated price lists on application.

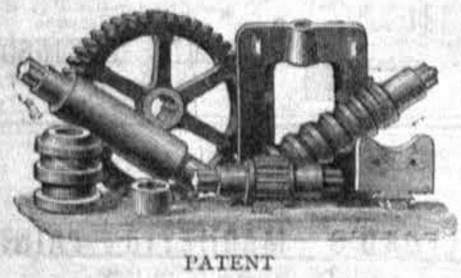
WILLIAMSON BROTHERS,

CANAL IRONWORKS,

KENDAL.

BAYLISS, JONES, & BAYLISS.

Manufacturers of



PATENT

Machine-Moulded Wheels,

GRAIN ROLLS and all kinds of

MILL & FORGE CASTINGS.

Pots and Pans for Annealing and Chemical Purposes, Columns and Girders, Engineers' and Colliery Castings, &c., &c.

FISH BOLTS, SPIKES,

And all kinds of

RAILWAY AND TRAMWAY FASTENINGS.

Tubular and Solid Bar Fencing, Iron Hurdles, Gates, &c., &c.

VICTORIA WORKS, WOLVERHAMPTON,

AND

3, Crooked Lane, King William St., London, E.C.

Martin and Son, Engineers, Iron Brass, and Malleable Iron Founders, Vine Street, York Road Lambeth.

Horizontal Engines, Lathes, Drilling Machines, Silent Fans, Blocks, Couplings, Shafting, Copying and Stamping Presses, Band Fly, Spur, Bevel, Cone, and Tram Wheels, Points, Curves, Crossings, Axle Boxes, Brasses, and General Castings, Malleable Iron Lathe Carriers, Screw Stocks and Spanners.

GAUNTLETT'S

Patent Pyrometer or Heat Gauge.

Recent improvements have rendered this Gauge extremely sensitive and durable. It is now made to register to 1500 deg. Fahrenheit. It is applied to Ovens, Heating Stoves, Boiler Flues, Heated Air, Hot Liquid Steam, Gases, &c. Testimonials on application.

W. H. GAUNTLETT, Middlesborough-on-Tees.

SMITH & McLEAN, GLASGOW

(ESTABLISHED 1852),

STEEL AND IRON SHEET ROLLERS

AND MANUFACTURERS OF EVERY DESCRIPTION OF

GALVANIZED AND CORRUGATED IRON

CLYDE GALVANIZING WORKS, GLASGOW.

GARTCOSH ROLLING MILLS NEAR COATBRIDGE.

CLAYTON AND SHUTTLEWORTH.

STAMP END WORKS, LINCOLN, AND 78, LOMBARD STREET, LONDON.

TWO GOLD MEDALS & OTHER PRIZES

Have been awarded to Clayton and Shuttleworth for their

STEAM ENGINES,	GRINDING MILLS,
THRASHING MACHINES,	TRACTION ENGINES, &c.

AT THE PARIS EXHIBITION, 1878

CATALOGUE FREE ON APPLICATION.

☞ **The Royal Agricultural Society of England** have awarded **First Prizes to Clayton and Shuttleworth** at every meeting at which they have competed since **1849.**

JOHN H. AUSTIN AND CO.,

90, CANNON STREET, LONDON, E.C.,

SUPPLY EVERY DESCRIPTION OF

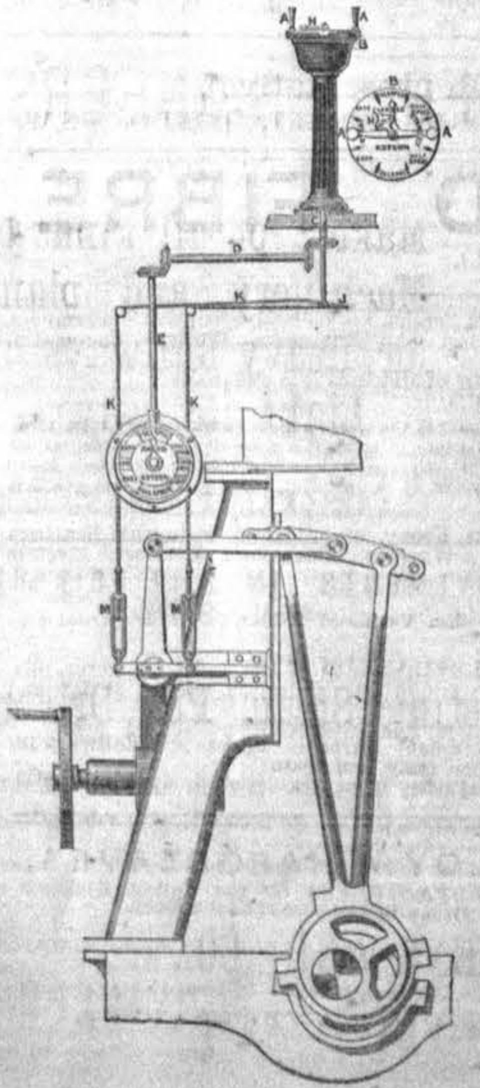
RAILWAY MATERIAL.

MINING COMPANIES, CONTRACTORS AND OTHERS are requested to send full particulars of their requirements, large or small.

OLD RAILS AND WROUGHT OR CAST SCRAP FOR EXPORT.

STEEL OR IRON RAILS, BESSEMER CROP ENDS, OLD STEEL RAILS, &c.

COLMAN'S AUTOMATIC ENGINE-ROOM AND BRIDGE TELEGRAPH.



This is the only BRIDGE TELEGRAPH in which the Engine itself replies to the Captain's orders.

By Royal Letters Patent.

APPLY TO

JAMES CHRISTIE

10, CITY CHAMBERS,

134, ST. VINCENT STREET,

GLASGOW:

JAMES P. THOL

18, MINCING LANE, E.C.;

OR TO

ARTHUR H. COLMAN,

NEWCASTLE-ON-TYNE.

JOHN MARSHALL & SONS,

(Late MARSHALL and WYLIE).

GLASGOW TUBE WORKS, GLASGOW.

MANUFACTURERS OF

LAP-WELDED STEEL AND IRON BOILER TUBES,

For Marine and Stationary Boilers, Locomotive and Portable Engines, &c.,

Supply the principal Engineers and Shipbuilders on the Clyde, and have a large Home and Foreign connection.

Locomotive Iron Tubes with Copper Ends.

BRANCH OFFICES:—LONDON: 9, LONDON STREET, FENCHURCH STREET,
NEW YORK: 58, HUDSON STREET.
SAN FRANCISCO: 22 & 24, FREEMONT STREET.

CAST IRON PULLEYS.

As shown below or in halves, made any diameter or width.

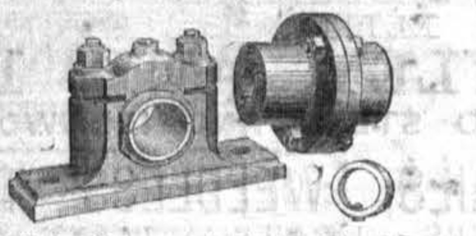
TAYLOR & CHALLEN,

DERWENT FOUNDRY,
BIRMINGHAM.

For each extra 1 inch in width add 10 per cent. to following prices:

Leading Sizes and Prices, Turned and Bored.

Diameter in inches	6	8	10	12	15	18	21	24	28	32	36	42	48	54	60
Width, ditto ...	2	2	2	3	3	3	3	4	4	4	5	5	5	6	6
Price, Split, shillings ...	8	9	10	11	14	17	20	25	32	38	46	55	66	95	110
Do. Plain do....	5	6	7	8	10	13	16	20	25	30	38	45	55	80	90



Plummer Blocks, with brasses and bolts, planed, bored, &c. Couplings, bored, faced, keywayed, and with turned bolts. Loose Collars of wrought iron bored, turned, and steel screws.

STOCK, SIZES, and PRICES, delivered here.

Bore, in inches to standard ...	1¼	1½	1¾	2	2¼	2½	2¾	3
PLUMMER BLOCK, ...each	6/	7/	9/	12/	15/	18/	22/	27/
COUPLINGS ...pair	8/	9/	11	14	17/	21	25/	30/
LOOSE COLLARS...each	2/3	2/6	2/9	3/3	3/9	4/3	5/	5/
SHAFTING, sup. qual. foot ...	1/5	1/8	2/	2/4	2/10	3/4	3/10	4

COATBRIDGE TIN PLATE AND SHEET IRON WORKS.

COATBRIDGE, near GLASGOW.

Manufacturers of COKE, BEST COKE, CHARCOAL AND BEST CHARCOAL TIN PLATES

Charcoal.	Charcoal.		Coke.	Best Coke.
B ♛ B Coatbridge.	— Glasgow.	Trade Marks:	— Manx.	B AND B Anchor.

Also Manufacturers of SHEET IRON—Various Qualities,
COMMON, BEST, CHARCOAL, STRIP IRON, MAIL SHEET, &c.

The Coatbridge Tin Plate Company (Limited).

REVOLUTION IN MACHINE BELTING.

SCANDINAVIA PATENT COTTON MACHINE BELTING

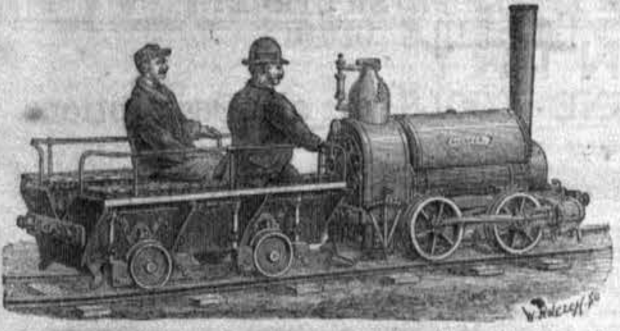
FROM ONE-HALF TO ONE-FIFTH THE PRICE OF LEATHER.

W. WILLSON COBBETT, 60, QUEEN VICTORIA STREET, LONDON, E.C.

Short length for trial suppliedat wholesale prices. (No post samples.)

RANSOMES & RAPIER, ENGINEERS,

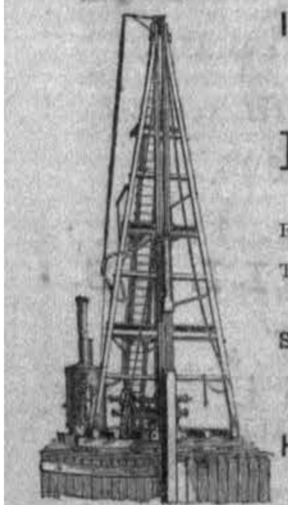
5, Westminster Chambers, London.



Makers of all kinds of Machinery and plant for Heavy Railways or Light Railways.

ALSO OF

CRANES OF ALL KINDS AND SIZES



IMPORTANT IMPROVEMENTS IN PILE-DRIVERS

BRONZE MEDAL. PARIS, 1878.

LACOUR'S

Patent Direct-Acting Steam Pile Driver.

Used in the Principal Government Harbours, Docks, and Railways in France, Italy, and Spain.

Effects considerable saving in time and money in the operation of driving piles through hard or soft ground.

The winch is only used for placing the pile in position, the monkey being operated by steam direct from the boiler.

The monkey can be readily fitted to the frame of an ordinary Pile Driver.

SOLE LICENSEES and MANUFACTURERS for the United Kingdom of Great Britain,

S. OWENS AND CO.,

HYDRAULIC AND GENERAL ENGINEERS.
WHITEFRIARS STREET, LONDON, E.C.

Illustrated Pamphlet and Price List Free.

LEATHER BELTING

JOHN WHITE & SONS,

BINGLEY, YORKSHIRE.

Manufacturers of Main Leather Driving Bands, Superior Machine Belting, Hard and Soft Roller Hides, Oak tanned and green picking Bands, Combing Leathers for Silk, Wool, Jute, Flax, &c., and every kind of Mechanical Leathers.

WIRE ROPES.

JOHN AND EDWIN WRIGHT,

Patentees, Established, 1770

Manufacturers of every description
OF IMPROVED
PATENT ROUND AND FLAT WIRE ROPES.

UNIVERSE WORKS, MILLWALL, POPLAR, LONDON.
UNIVERSE WORKS, GARRISON STREET, BIRMINGHAM.
CITY OFFICE—5, LEADENHALL STREET, E.C.

All communications should be forwarded to the Birmingham Address.

S. B. WHITFIELD,

Manufacturer of

Metallic Bedsteads, Cots, Chairs, &c.,

GLADSTONE WORKS,
WATERY LANE, BIRMINGHAM.

IRON.

The new Series commenced January 2nd, 1880.

IRON

Is an Illustrated Weekly Journal of Science, Metals and Manufactures in IRON AND STEEL.

IRON

Was established in 1823 as the "Mechanics' Magazine."

IRON

Has, therefore, been established more than half a century.

IRON

Is now conducted by Perry F. Nursey, C.E.

IRON

Is largely circulated on the Continents of Europe and America, and in the Colonies.

IRON.

The Circulation of this Paper will compare favourably with that of any other Journal of its class.

IRON

Is printed every Thursday evening, and published early on Friday morning.

IRON.

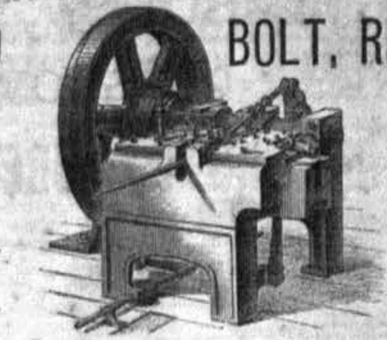
Communications respecting Advertisements Copies or General Business must be Addressed to the New Offices, 161, Fleet Street, London, E.C.

IRON.

Advertisements for this Paper must be sent in not Later than 6 p.m. on Thursday.

GOLD MEDAL, PARIS UNIVERSAL EXHIBITION, 1878.

HORSFALL'S PATENT COMBINED BOLT, RIVET, & NUT FORGING MACHINES



MAKES BOLTS
WITH
SQUARE, HEXAGON OR CHEESE HEADS,
AND WITH
SQUARE OR ROUND NECKS.
WHICH DO NOT REQUIRE
DRESSING OR FINISHING BY HAND.

OVER 60 OF THESE MACHINES HAVE BEEN SUPPLIED TO BOLT AND NUT MANUFACTURERS, ENGINEERS, &c.

MADE IN THREE SIZES, TO MAKE FROM THREE-EIGHT INCH TO ONE AND A HALF INCHES DIAMETER, ANY LENGTH.

MAKES NUTS,
SQUARE OR HEXAGON,
WITHOUT
ANY LOSS IN PUNCHING,
AND DOES NOT REQUIRE
DRESSING OR FINISHING BY HAND.

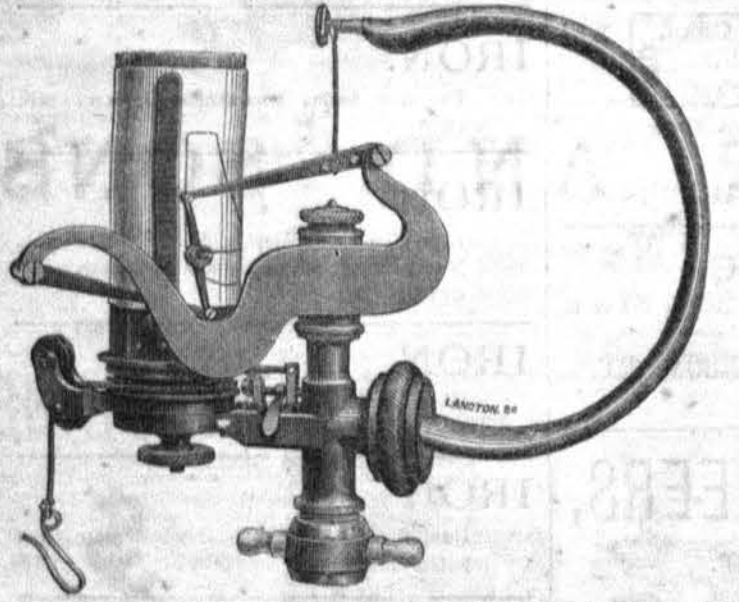
TO SEE MACHINES WORKING,
APPLY TO
SAMUEL MARSDEN AND SON,
SOLE OWNERS OF PATENT,
MANCHESTER SCREW BOLT WORKS,
MANCHESTER.

NO SKILLED LABOUR REQUIRED TO WORK THESE MACHINES.

GOLD MEDAL, PARIS, 1878.

BROWN, BAYLEY AND DIXON, LIMITED.
THE SHEFFIELD STEEL AND IRONWORKS, SHEFFIELD,
MANUFACTURERS OF
BESSEMER STEEL RAILS, WELDLESS TYRES, AXLES, SPRINGS,
And of BUFFERS and RAILWAY PLANT of every description.
Also Makers of PLANISHED STEEL BARS for Shafting for Engineers, Machinists, Agricultural Implement Makers, &c
CAST, SHEAR and SPRING STEEL FILES, SAWS, &c., STEEL FORGINGS of all Descriptions, and STEEL CASTINGS.
STEEL SHIP AND BOILER PLATES.
SOLE MAKERS FOR THE UNITED KINGDOM AND THE COLONIES OF STEEL WELDLESS CHAINS AND CABLES.
LONDON OFFICE:—1. QUEEN VICTORIA STREET, E.C.

KENYON'S PISTONLESS STEAM ENGINE INDICATOR.



Secured by Royal Letters Patent, No. 1278,
Dated April 1st, 1878.

SOME ADVANTAGES:

Having no piston it has no friction to overcome, and cannot be fouled by grit or silty steam.

Is more sensitive and reliable than a Piston Indicator.

Can easily be tested on a reliable test pump.

SOLE MAKERS:
ISAAC STOREY AND SONS,
CATHEDRAL YARD, MANCHESTER:
And at LITTLE PETER STREET.

SMITH & COVENTRY
Makers of PATENT SPECIAL and GENERAL MACHINE TOOLS of all Descriptions.
MANUFACTURERS OF

STRAIGHT LIP TWIST DRILLS.
OF THE HIGHEST QUALITY, WITH GRINDING LINE. A LARGE STOCK ALWAYS READY FOR DELIVERY.
GRESLEY IRON WORKS, ORDSAL LANE, SALFORD, MANCHESTER
LONDON OFFICE: 46, FISH STREET HILL, E.C., W. PARSEY, Agent, where the TWIST DRILLS may also be obtained from Stock.

RANSOMES, SIMS AND HEAD,
ORWELL WORKS, IPSWICH, ENGLAND,
ENGINEERS AND MANUFACTURERS OF THE BEST
AGRICULTURAL MACHINERY,
ADAPTED
FOR ALL COUNTRIES, CROPS AND SOILS,
INCLUDING
PORTABLE STEAM ENGINES
EXPANSION ENGINES,
STRAW-BURNING ENGINES,
STEAM THRESHING MACHINES,
CORN SCREENS AND WINNOWERS,
SINGLE FURROW PLOUGHS,
DOUBLE FURROW PLOUGHS,
FOREIGN & COLONIAL PLOUGHS,
HORSE RAKES AND HAYMAKERS.

ILLUSTRATED CATALOGUES FREE BY POST ON APPLICATION.

London Office: 9, GRACECHURCH STREET.

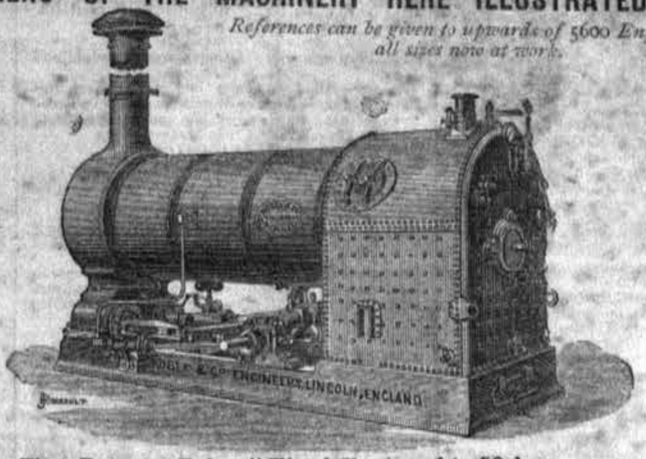
CORPORATE MARK.

Granted according to Act of Parliament, 1777, by the Cutlers' Company, Sheffield.
TOOLS, STEELS, FILES,
R. MUSHET'S SPECIAL STEEL.
Railway Springs, Steel Castings, Shear and Spring Steel, &c., &c
SAMUEL OSBORN AND CO.
CLYDE STEEL AND IRON WORKS, SHEFFIELD.
LONDON: 16, PHILPOT LANE, E.C.; BOSTON (U.S.): 10, OLIVER STREET;
MONTREAL: 470, ST. PAUL STREET; BERLIN: 48, NEUE FRIEDERICHS STRASSE.

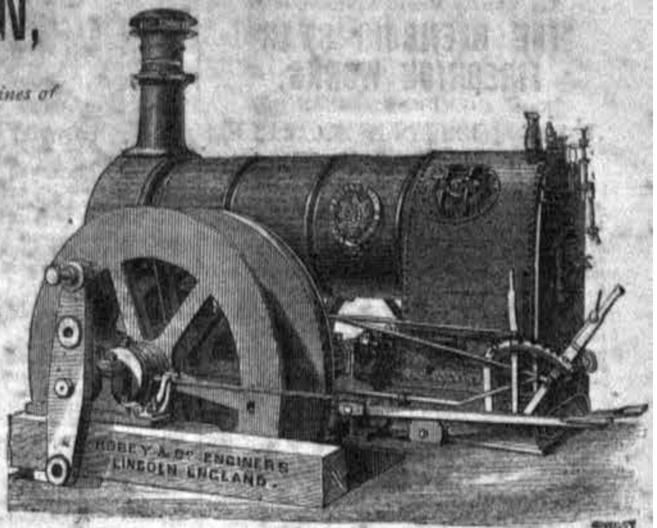
ROBEY AND CO., ENGINEERS, LINCOLN,
SOLE MANUFACTURERS OF THE MACHINERY HERE ILLUSTRATED.

References can be given to upwards of 5600 Engines of all sizes now at work.

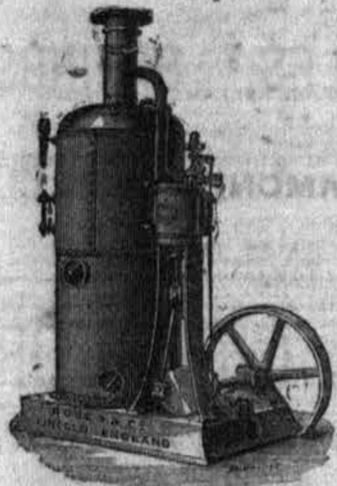
Superior Portable Engines, 4 to 50 h.-p.



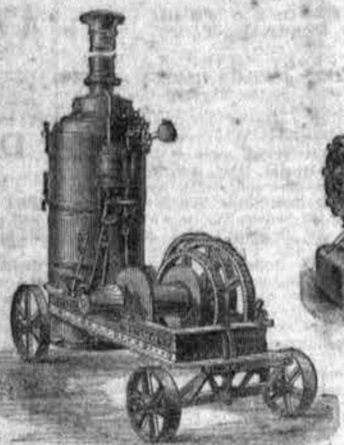
The Patent "Robey" Fixed Engine, 4 to 50 h.-p.



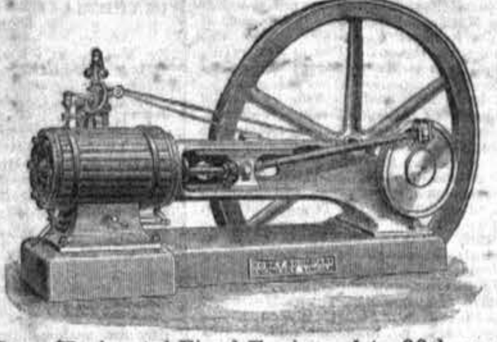
Patent "Robey" Mining Engine, 4 to 200 h.-p.



Vertical Engines, 1½ to 1 h.p.

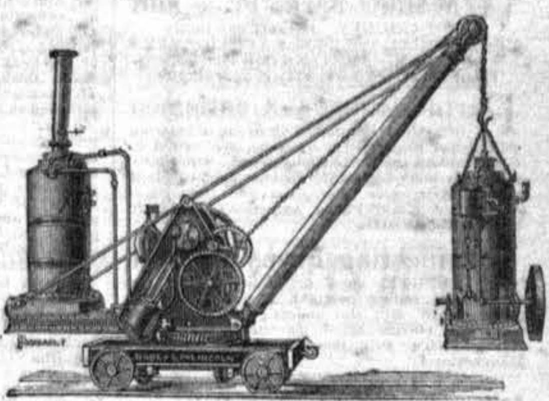


Improved Steam Travelling Crane



Horizontal Fixed Engines, 4 to 60 h.-p.

ROBEY & CO.,
ENGINEERS,
LINCOLN, ENGLAND.
Catalogues, Prices and Photographs on Application.



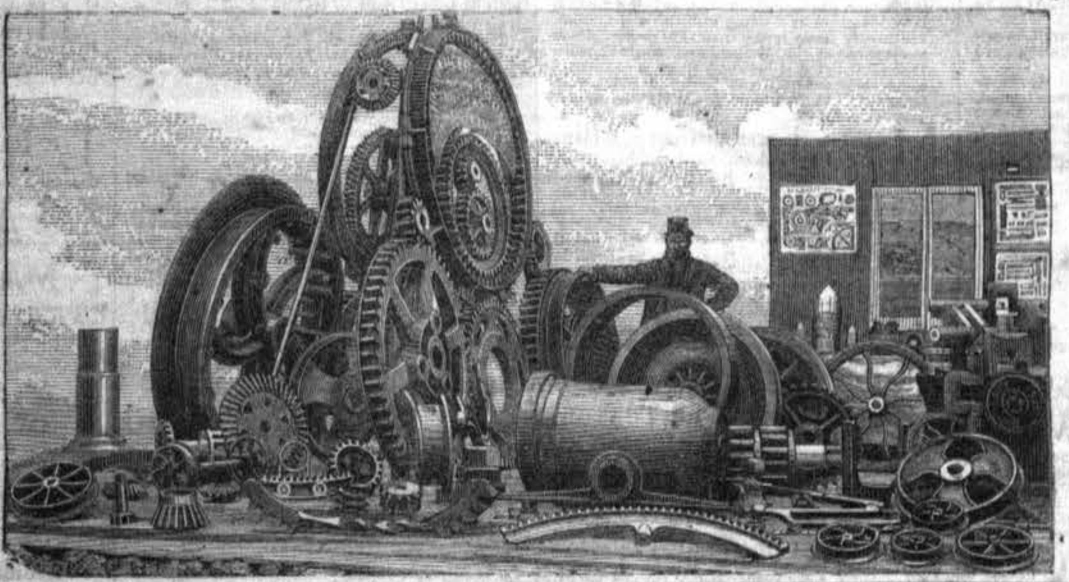
Improved Barrow Hoist.

JOHN SPENCER AND SONS,
Newburn Steel Works, Newcastle-on-Tyne.

STEEL
CASTINGS

TRADE MARK.

ORIGINAL MANUFACTURERS OF
VOLUTE SPRINGS.
Best Cast Steel Files.



STEEL
FORGINGS

TRADE MARK.

RAILWAY
SPRINGS & BUFFERS.
Best Cast Steel or Tools.

GEORGE SALTER & CO., West Bromwich
Manufacturers of SPRING BALANCES,
Roasting Jacks, Sad Irons,
Bourdon's, Schaeffer's and Silvester's
PRESSURE GAUGES
COLLIERY SIGNAL BELLS, RASTRICK'S TUBE SCRAPERS,
Conical, Spiral, & all kinds of Coiled Springs
MADE TO ORDER.

VALVE SPRING

SCHAEFFER GAUGE

BOURDON GAUGE

VALVE SPRING

COLLIERY BALANCE UP TO 1 TON

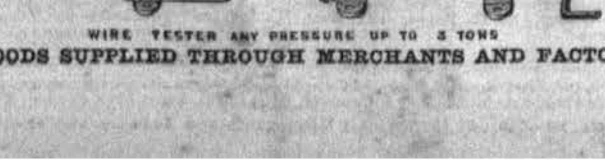
SILVESTERS PATENT SAD

CONICAL SPRING

NEW OLIVER SPRING

LOOSE HANDLED SAD

KELLY'S DOOR SPRING



WIRE TESTER ANY PRESSURE UP TO 5 TONS

RASTRICK'S PATENT SCRAPER

GOODS SUPPLIED THROUGH MERCHANTS AND FACTORS.

Two Silver Medals, Paris, 1878,
The Chilian Medal, Santiago, 1875.

THE GLENBOIG STAR FIREBRICK WORKS,

Near COATBRIDGE, N.B.

JAS. DUNNACHIE,
2, *West Regent Street, Glasgow.*

Contractor to Her Majesty's Government.

Manufacturer of Fire Bricks for Steel, Iron, Brass, Gas, Chemical and Glass Furnaces, Copper roasting, calcining and refining furnaces. The special bricks for the Siemens regenerative gas-furnace (this is the brand recommended by Dr. C. W. Siemens). Bessemer tuyeres, runners, plugs and stoppers. German tubes. Gannister of highest quality, ground fireclay. No other firebrick combines such a high degree of infusibility with the perfect absence of cracking and splitting up under sudden cooling.

Each brick bears the registered Trade Mark,

Star Works
Trade J ✱ D Mark
Glenboig

Quotations, Illustrated Catalogues, &c., on application.

Shipping ports, Glasgow, Grangemouth, Leith, Granton, Boness, &c.

London Agents: Messrs. Doulton and Co., Lambeth Pottery, and Crown Wharf, Victoria Park, E.

Wheatley Kirk, Price and GOULTY. Established 1850.
MECHANICAL VALUERS, AUCTIONEERS AND ARBITRATORS.
Head Offices—Albert Square, Manchester.

Partnerships. — Gentlemen (Practical Engineers) desirous of entering established Engineering concerns, are invited to communicate with the undersigned, who have numerous bona fide establishments open to admit such. References are given and required.—Wheatley Kirk, Price and Goulty, Albert Square, Manchester.

Engineering Firms of Good REPUTE, open to admit partners, or desirous of selling outright, are requested to communicate with the undersigned, who have numerous clients open for such.—Wheatley Kirk, Price and Goulty, Albert Square, Manchester.

IN LIQUIDATION.

To be Sold by Private TREATY, as a going concern, on the Great Northern Line of Railway, a well-established ENGINEERING BUSINESS, comprising the following branches, viz:—

The Manufacture of Stationary Engines and Boilers.
Portable and Combined do.
Agricultural Implements of all classes.

And especially the Manufacture of Wrought Iron Cranks, for which a complete Plant of Patent Machinery has been put down; also General Iron Founding with all the Appliances for carrying on and extending a first-class trade.

The Machinery and Tools are by well-known makers, and the new Buildings are erected upon land secured on a 999 years' lease.

Full particulars can be obtained from Mr. Isaac Jenks, of Wolverhampton; Mr. Thomas Leman, Accountant, Nottingham; or Messrs. Corser, Fowler and Langley, Solicitors, Wolverhampton.

For Sale, about 250 Tons BESSEMER STEEL, consisting Ingot Ends, &c.—

60	Tons	30	W STEEL RAILS, new.
50	"	40	" " " "
25	"	42	" " " "
20	"	50	" " " "
70	"	45	D IRON RAILS, new.
150	"	40	" " " "
40	"	35	" " " "
80	"	56	" " " "

With all Fastenings complete if required.—Apply, "Rails," Office of this Journal.

IRON MANGANESE AND SPATHOSE ORES.

Messrs. Thomson & Wright, 10, Cornhill, London, are prepared to enter into Contracts for supplying in large quantities the best SPANISH IRON ORES; also rich MANGANESE and SPATHOSE ORES.

☞ Particulars on application.

TO BE LET OR SOLD.

The Broughton Hall Iron-WORKS, near Wrexham. Lately worked by Mr. Plant, who has retired in consequence of illhealth.—For further particulars apply to Charles Ryland and Son, Metal Brokers, 6 and 7, Exchange Buildings, Birmingham.

Waterside Premises. — WAREHOUSES to LET with or without frontage to River Thames, in portions to suit applicants.—Apply, 4, Upper Thames Street, London, opposite "Times" Office.

Wanted, Price Lists and CATALOGUES from manufacturers and others of supplies for GLASS, IRON AND STEEL AND CHEMICAL WORKS, only such as are apt to compete with those of American production, by the undersigned, who has an established trade with above works in the United States. References to first-class firms in England, Germany and America forwarded on application, or can send cash with orders. Quote lowest prices f.o.b. ocean vessels, and send small sample, together with testimonials and your telegram address.—Rudolph Frank, Importer and Commission Merchant, 220, Fulton Street, New York, U.S.A. Telegram Address: "Fireclay, New York."

To Ironmasters and Others. —For Sale a large quantity of HAND LEATHERS and PIG-IRON LIFTERS LEATHER APRONS.—For samples and prices apply to John Nicholson and Co., 208, Vauxhall Road, Liverpool.

Upset Price £30,000.—In the High Court of Justice, Chancery Division: Forster v. Forster.—Durham.—Important Leasehold Seasale Collieries, known as East Hetton and Trimdon Grange, extending under about 3600 acres, intersected by the North-Eastern Railway, and situate about [illegible] miles from Durham, five miles from Ferry Hill, and 14 from the port of shipment at Hartlepool.

Mr. John Whittaker Ellis (of the Firm of Farebrother, Ellis, Clark, and Co.) will SELL the above by AUCTION, as going concerns, in one lot, at the Mart, Tokenhouse Yard, London, on WEDNESDAY, 19th May, 1880, at 2 o'clock precisely (pursuant to an order in the above action, and with the approbation of the Master of the Rolls). The EAST HETTON COLLIERY, comprising 2740 acres, includes the Town Kelloe, Kelloe Glebe, and Garmondsway Moor Royalties. The Colliery has every facility, by means of appropriate shafts, buildings, and works, and by ready communication with all the best markets by its own branch line, in connection with the North-Eastern Railway, to the ironworks of Cleveland, and to the southern markets, or to the Tyne, Sunderland, Middlesborough, and also by the Hartlepool Branch Railway, which places it in a direct route to the shipping ports for the home and export trades. The engines are of a most powerful description, capable of raising an output of 260,000 tons per annum, and there is sufficient coal unworked (it is estimated) to supply a vend for the next thirty years. The adjacent Trimdon Grange Colliery, comprising 854 acres, includes Trimdon Grange, Town Kelloe (part of), and North-side Royalties. The Colliery is situate about three-quarters of a mile from the Trimdon Station of the Hartlepool and Ferry Hill branch of the North-East Railway Company's system, and in connection with the main line at Ferry Hill. The Colliery is in first-rate working order, and is capable of raising an annual output of 180,000 tons of excellent household coal, known as Raisby South Hartlepool and Trimdon Grange Wallsend. The available unworked coal (it is estimated) is sufficient to supply a vend to the extent named for the next 30 years; also a Freehold Property, comprising a plot of land of about six acres, on which are erected 60 workmen's cottages; and about an acre of land, situate close to the Trimdon Station, on which are 33 cottages. The sale comprises a number of other cottages, erected on leasehold property, and also ample machinery and working plant. Particulars, with conditions of sale, plans, and further information may be obtained on application to Messrs. Trinders and Curtis Hayward, Solicitors, 4, Bishopsgate Street, Within, E.C.; T. W. Denby, Esq., 8, Frederick's Place, Old Jewry, E.C.; J. Anderson Rose, Esq., 11, Salisbury Street, Strand, W.C.; G. B. Forster, Esq., Backworth, Newcastle-on-Tyne; W. O. Wood, Esq. (the Viewer), East Hetton Colliery, Coxhoe, County Durham; Matthew Forster, Esq., 1 Temple Gardens, Temple, E.C. (the Receiver); R. F. Matthews, Esq., Seaton Carew, West Hartlepool; and of Messrs. Farebrother, Ellis, Clark, and Co., 5 and 6, Lancaster Place, Strand, W.C., and 18, Old Broad Street, London, E.C. Orders to view may be had of Messrs. Trinder and Curtis-Hayward, and of Messrs. Farebrother, Ellis, Clark, and Co.

Northamptonshire.—The Woodford House Estate, a highly important Freehold Residential Property, of upwards of 750 acres, possessing great mineral value, as some of the richest beds of iron ore and limestone underlie the greater portion of the Estate, parts of which are now being worked. It is connected by a siding with Twywell Station, and is only three miles from Thrapston, which has stations on the Midland and North-Western Railways, and it is believed there is no district where these minerals can be found under more favourable circumstances or put into the market at a cheaper rate.

Messrs. Farebrother, Ellis, CLARK, and Co. beg to announce that the above valuable RESIDENTIAL and MINERAL PROPERTY was NOT SOLD at the recent Auction, and may now be treated for.

By order of the Devisee in Trust under the will of the late Wm. James, Esq.—Gloucestershire, in the Forest of Dean.—Valuable Mining Properties, extending over an area of about 200 acres (of which about 30 acres have been partially worked), and containing an abundance of hematite iron ore of rich quality, yielding a very high percentage of pure metal, together with the joint ownership with Messrs. Henry Crawshay and Sons of a private tramway, communicating direct with the Severn and Wye Railway.

Messrs. Debenham, Tewson, FARMER and BRIDGEWATER will SELL, at the Mart, on TUESDAY, May 11th, at 2, in three lots (unless an acceptable offer or offers be previously made), the following important IRON MINES:—

Lot 1.—The Oakwood Mill Deep Level, situate near Bream, about three miles from Lydney and four from Coleford. Held under an award from the Crown for 500 years from March, 1825, at a dead rent of £15 per annum and a royalty of 4d. per ton on all ore raised in excess of [illegible] tons per annum. A portion of this lot is sub-leased for seven years, at a certain dead rent of £200 per annum, and a royalty of 1s. 9d. per ton upon all ore in excess of 2285 tons per annum. The remainder is in hand. Also an undivided Moiety of the Oakwood Tramway, a valuable property, 1½ mile in length, from which a large income is derived in the shape of tolls.

Lot 2.—The Scar Pit, a freehold grant or gale from the Crown, overlying a portion of the Oakwood Deep Level Mine. This lot is subject to a dead rent of £5 per annum, and a royalty of 4d. per ton on all ore over 300 tons per annum. With possession.

Lot 3.—The Frog Pit, a freehold grant or gale from the Crown, overlying a portion of the Oakwood Deep Level Mine. Dead rent £5 per annum, royalty 4d. per ton on all ore exceeding 300 tons per annum. With possession.

The mines are adjacent to the extensive works of Messrs. Henry Crawshay and Sons, at Parkend. Particulars of W. Caister, Esq., Solicitor, 8, New-inn, Strand; of J. J. James, Esq., The Hoggins, St. Briavels, near Coleford; of Mr. Wm. Trafford, Mining Engineer, Bream, near Lydney; and of the Auctioneers, No. 80, Cheapside.

A Draughtsman, who has a practical acquaintance with the various departments of shipbuilding, a knowledge of Engineering, and with five years' experience in the Drawing Office, desires a re-engagement. He has excellent testimonials as to his ability and character.—Address, S. H. Beale, 109, Kent Road, Glasgow.

H. AUGUSTUS GUY AND COMPANY,

Government Contractors and Medallist
STEEL CONVERTERS AND REFINERS.
Sole proprietors and manufacturers of

GUY'S 'INVINCIBLE,' 'RELIABLE,' & 'MINING' TOOL STEEL.

Steel Forgings and Castings of every weight and Section.

The unequalled excellence and undeviating uniformity of these famous Brands secure an immense economy in the workshop and the mine.

Inventors and Sole Makers of the

"IMPERIAL" METAL.

An economical and efficient substitute for ordinary brass and gun metal, being much more durable and cheaper than these materials.

GUY'S "TRUE" BOILER CLEANER & FUEL ECONOMISER.

For removing and preventing incrustations in land and marine Boilers. It prevents oxidation, secures a material saving in fuel, and doubles the life of the Boiler.

Chief Offices:
11, CLOAK LANE, CANNON STREET, LONDON, E.C.

Works.—The "Imperial" Metal and Steel Works Peckham, London, S.E., and Sheffield.

Full descriptive price Lists on application.

GRAHAM STREET FOUNDRY AND NINE SHOPS ADJOINING.—BRADFORD.

IN THE MATTER OF E. C. RHODES & Co.'s ASSIGNMENT.

By Mr. J. BUCKLEY SHARP, at the Talbot Hotel, Bradford, on THURSDAY, May 13th, 1880, at Six o'clock in the Evening (for Seven precisely), in One Lot,

The well-known and Extensive Foundry, for many years past in the occupation of Messrs. E. C. Rhodes and Co., and now of the Trustees under their Assignment, and called the "Graham Street Foundry," having frontages to Graham Street, Augustus Street, and Ernest Street, in Bradford, and comprising Foundry, Fitters' and Joiners' Shops, Model Rooms, Engine and Boiler Houses, convenient suite of Offices, Stabling and other buildings.

The premises were specially arranged for a foundry, but are readily adaptable for any works of a mechanical nature, and form a most desirable site for business premises. The plant is in a capital working condition, and immediate possession can be given of the whole.

The fixed machinery and plant, of which a schedule will be produced at the sale, is not included in the lot, but the purchaser will have the option of taking the same at a valuation, as provided by the conditions of sale.

Also, the Nine SHOPS, with the Hay Chamber and Blacksmiths' Shop adjoining, and fronting to Graham Street aforesaid, and forming the northern boundary of the foundry premises, and close to one of the entrances to St. James' Market. These shops are excellently built, and all let, producing a low gross rental of £136 10s. per annum. The tenants are disposed to accept leases of their respective holdings.

The whole estate forms a compact lot, containing an area of 2841 square yards, contiguous to the sidings of the Great Northern Railway, at Hammerton Street. Part of the purchase money may remain on mortgage if required.

For further information and permission to view the premises, apply to Mr. Frederick Ronnfeldt, Accountant, Hustlergate; Mr. R. R. Priestley, Accountant, 5, Little Horton Lane; the Auctioneer, Well Street; or to

R. NEWTON RHODES, Solicitor.
Swan Arcade, Bradford.

London, S.W.—For Sale, in consequence of the death of the Proprietor, an IRONMONGER'S BUSINESS — Black. Has been in the same family 63 years. Premises large and commodious, held on lease at a low rental.—Apply, No. 1001, Office of Iron, 161, Fleet Street, London, E.C.

Spring Hill, Birmingham, BRASS AND COPPER ROLLING-MILLS. BRASS AND COPPER WIRE MILLS.

BRASS AND COPPER LOCOMOTIVE, MARINE, AND GAS TUBE MILLS. CARTRIDGE METAL MILLS.

Proprietors:
GLYDON, SHORTHOUSE and GLYDON.

DER PRACTISCHE

Maschinen-Constructeur.

Zeitschrift für Maschinen- und Mühlenbauer, Ingenieure und Fabrikanten,
Unter Mitwirkung bewährter Ingenieure und anderer Fachmänner des In- und Auslandes
herausgegeben von
Wilhelm Heinrich Uhland,
Civil-Ingenieur und Patent-Anwalt in Leipzig.

Verlag von BAUMGARTNER'S BUCHHANDLUNG in Leipzig.

Inhalt des 9. Heftes: Vorrichtung zum Herausziehen der Kernspindeln bei Abflussrohren.—Die Aufstellung und Construction der „Points-Kettenbrucke in Pittsburg in Nordamerika.—Verticale Kesseldampmaschine.—Ueber Entstehung von Dampfkessel-Explosionen.—Der Hörstmann'sche rauchverzehrende Stubenofen ohne Schornstein.—Zwillings-Pumpmaschine von Weise and Monski, Maschinenfabrik in Halle a/S.—Landwirthschaftliche Maschinen von Newton Wilson & Co. in London.—Wasserstandsapparat mit selbstthatigen Schluss beim Bruche des Wasserstandsglases von Wilh. Kramer, Maschinen- und Dampfkessel-Armaturen-Fabrik in Halle a/S.—Rohrendampfkessel von der Colner Maschinenfabrik Carl Biessel and Co. in Ehrenfeld bei Coln.—Ueber Scharfen von Feilen und anderen kleinzahnigen Werkzeugen mittelst Sandstrahlgebläse. — Pulverisirmaschine. — Selbstthatiges Absperrventil in Schmidefeuer-Windleitungen, Von H. Kuppers in Kalk.—Ueber die Damfkesselheizer- und die Maschinenwarterschule des Gewerbevereins fur Hanover.

Der „Practische Maschinen-Constructeur" erscheint in halbmonatlichen Heften und kostet pro Quartal (6 Hefte mit Holzschnitten und 24 autograph. Tafeln, sowie vielen Skizzenblattern) 6 Mark 75 Pfg. Einzelne Hefte werdennicht abgegeben! In London bei Herrn Williams and Norgate, 14, Henrietta Street, Covent Garden.

Galvanised Ironwork
Tanks, &c.
PORTEOUS & CRAWFORD,
ANDERSTON GALVANISING WORKS,
91, ELLIOT STREET,
GLASGOW.

NOTICES.

ORES, MINERALS & METALS,

IMPORT AND EXPORT.

The only house in America giving Special Attention to Manganese and Manganiferous Iron Ores.

Address:
WILLIAM D. MARVEL,
NEW YORK.
Telegrams: "Marvel, New York."

JOHN BELLAMY,

BYNG STREET, MILLWALL, LONDON, E.
Manufacturer of
WROUGHT IRON TANKS AND CISTERNS.

Cattle, Sheep, and Pig Troughs, Cart Bodies, Corn, Flour, and Sack Bins, Funnels, Shoots, Hoppers, Boilers, and every Description of Wrought Iron work either painted or galvanised.

The only BELLAMY in the Trade.

No connection with any other house trading under this name.

DIAMOND BORING.

ARTESIAN WELLS bored STRAIGHT and TRUE—Large and small diameters—easy to line and put down Pumps—Tenders given for Wells, Pumping Machinery, and Engines, complete.

PROSPECTING FOR MINERALS to any depth—The only system by which a true section of the strata can be obtained from the cylindrical cores taken out.

Total boring by this system in Great Britain to end of last year, 194,000 feet.

For terms apply to John Vivian, C.E., Whitehaven, Cumberland.

Leroy's Improved Patent Non-Conducting Composition for Coating Boilers, Steam Pipes, and other highly-heated surfaces. Superior to Felt or any other composition, for economy, durability, adhesiveness, and effectiveness. Prevents the radiation of heat, saves fuel, increases the power of steam, and keeps the stoke-hole and engine-room cool. It will at once show a leak, and cannot catch fire. Used all over the world.

F. Leroy and Co., Sole Manufacturers, 8, Gray Street, Philpot Street, Commercial Road, E., and Griffith Street, Lower Broughton, Manchester.

New Edition.

"How to Make Money by PATENTS." Free, by post, 14 stamps.—Barlow and Young, Patent Agents and Consulting Engineers, 23, Southampton Buildings, W.C.

AVIS IMPORTANT.

Le Journal "Iron" (le Fer) traite de toutes les matières relatives au Commerce et à la fabrication du fer. Il donne les prix-courants des spécialités de Birmingham, Sheffield et districts voisins. Les colonnes en sont ouvertes aux rapports scientifiques et commerciaux publiés sur les métaux et sur la quincaillerie de tous les pays du monde. On y trouvera des comptes rendus et des appréciations étendues sur la fabrication du fer et sur toutes matières ayant rapport à la métallurgie, aux hauts-fourneaux, etc., ainsi que des descriptions variées sur les diverses usines. Le Journal "le Fer" ayant une circulation considérable parmi les manufacturiers, négociants et exportateurs des deux continents est de la plus haute importance pour tous ceux qui ont à insérer des annonces industrielles ou métallurgiques.

Le journal se publie tous les Vendredis.

Le prix du numéro est de 0 f. 60 c. et le coû de l'abonnement est de 38 f. par an., frais de port compris.

On est prié d'adresser toutes communications au Directeur de l'Iron, No. 161, Fleet Street, London, E.C.

A SILVER MEDAL, PARIS, 1878,

For Excellence of Quality,

WAS AWARDED TO

THE GLENBOIG FIRE CLAY COMPANY,

ESTABLISHED 1836.
Office: 68, BATH STREET,
GLASGOW.

MANUFACTURERS OF FIRE BRICKS FOR HIGH HEATS AND SUDDEN CHANGES OF TEMPERATURE.

Repairs in smelting, puddling and other furnaces occasion such expense and loss of time that it becomes a matter of the greatest necessity to build these furnaces of bricks possessing the highest refractory power. Our experience shows that wherever our bricks have been introduced, they have superseded those of local make. They are specially adapted for Siemens' regenerative gas furnaces; for blast, puddling and glass furnaces; every description of furnace exposed to the most intense heats and sudden changes of temperature, as they do not crack and drop when quickly cooled or heated. References can be given both in Great Britain and the Continent to many of the largest firms in the iron, steel and other trades where our fire bricks are in constant use.

Quotations given delivered at Antwerp, Rotterdam, Bremen, Hamburg, Havre, Dunkirk, &c.

Shipping ports, Glasgow, Leith, Grangemouth, Granton, Boness, &c. &c.

Published by the Proprietors, every Friday, at their Offices, 161, Fleet Street, E.C., in the City of London, where all communications, whether for Editor or Publisher, are to be addressed.
Printed for the Proprietors by Bradbury & Company, 12, 13 and 14, Fetter Lane, London, E.C.—May 7, 1880.
Copies of IRON can be obtained through all Newsagents and Vendors, and at all Railway Bookstalls.

Cur Furn
~~[illegible]~~
~~[illegible]~~
McPhine

FOREIGN EDITION.

IRON.

An Illustrated Weekly Journal of Science, Metals, and Manufactures in

IRON AND STEEL.

ESTABLISHED IN THE YEAR 1823 *AS "THE MECHANICS' MAGAZINE."*

CONDUCTED BY PERRY F. NURSEY, C.E.

PUBLISHED EVERY FRIDAY, FOR CIRCULATION IN THE UNITED KINGDOM, AND ON THIN PAPER (UNDER 4 OZ.), FOR FORWARDING TO ALL PARTS OF THE WORLD.

No. 384. VOL. XV. LONDON, FRIDAY, MAY 21, 1880. Price SIXPENCE. Registered as a Newspaper for Transmission Abroad.

CONTENTS.

(For Contents see Correspondence column).

LOWOOD'S
GROUND CANISTER.
For Lining all kinds of Furnaces, and
NON-EXPANSIVE GANISTER BRICKS,
Superior to ordinary Silica, and equal to three lives of Fireclay brick.
J. GRAYSON LOWOOD & CO.,
78, ATTERCLIFFE ROAD, SHEFFIELD.

CHEMISTRY.

Henry S. Bell, F.C.S., Associate of the Royal School of Mines, London, &c., Analytical and Consulting Chemist. Office and Laboratories, 46, High Street, Sheffield (*Successor to the late Mr. William Baker*).

Analyses of Iron and Steel, Spiegeleisen, Manganese, Ores of all kinds, Nickel and Copper, Alloys, Coal and Coke, Fireclays, &c., performed on reasonable terms.

Gentlemen visiting Sheffield to study Chemistry will find every convenience in the Laboratories at the above address.

GEO. ANGUS AND CO.
Manufacturers and Dealers in every description of
LEATHER, INDIA-RUBBER, AND GUTTA-PERCHA GOODS
FOR GENERAL MECHANICAL PURPOSES
Contractors to the Admiralty.
ST. JOHN'S LEATHER AND INDIA-RUBBER WORKS,
NEWCASTLE-ON-TYNE.
AND 10, THOMAS STREET, LIVERPOOL.
London Agency:—187, UPPER THAMES ST.

ASBESTOS.

ASBESTOS ENGINE PACKING.
ASBESTOS MILLBOARD JOINTING,
ASBESTOS BOILER COVERING,
ASBESTOS CEMENT,
ARE UNRIVALLED.
SOLE PATENTEES & MANUFACTURERS
THE PATENT ASBESTOS MANUFACTURE COMPANY, LIMITED,
31, ST. VINCENT PLACE, GLASGOW; and 10, MARSDEN STREET, MANCHESTER; From whom Price Lists and all Information can be had.

ESCHERICH'S GAS KILN,

As described in IRON, April 16th; the only successful Gas Kiln for burning goods of a delicate colour, facing bricks, fire bricks, pottery and china, &c., at a great saving in fuel. For particulars, apply to

HERMANN WEDEKIND,
158, FENCHURCH ST., LONDON, E.C.

ISAAC JENKS & SONS,
Manufacturers of
SPRING STEEL, CAST STEEL, &c.
RAILWAY SPRINGS, COACH SPRINGS, SHEET AND BAR IRON,
TAPER BRAKE, LEVER BARS, &c.
Minerva & Beaver Works, Wolverhampton.
Brand, Steel JENKS. Brand, Iron BEAVER.

Steam Hammers, with or WITHOUT GUIDES, Hand-worked or Self-acting. Machine Tools for Shipbuilders or Boiler-makers.
DAVIS AND PRIMROSE, Leith.

BIRMINGHAM
PATENT TUBE COMPANY.
SMETHWICK TUBE WORKS, Near BIRMINGHAM.
London Office—77, Cannon Street, E.C.

LAP-WELDED, IRON, STEEL,
HOMO METAL,
BRASS & COPPER BOILER TUBES, &c.

MAISON FONDÉE EN 1844.
CALEDONIAN TUBE COMPANY,
COATBRIDGE, PRÈS GLASGOW.
FABRICANTS DE
TUBES EN FER A RECOUVREMENT BREVETES
POUR
CHAUDIERES MARINES, DE LOCOMOTIVES, &C.

à cause des arrangements spéciaux à l'usine, nous sommes prêts en toute occasion à fournir rapidement aux commandes, et de faire à la hâte toutes espèces de réparation.

MAYBURY, MARSTON AND SHARPE,
FORGE DE LA PERSEVERANCE
(Perseverance Ironworks)
PENDLETON, MANCHESTER, ANGLETERRE

Marque de fabrique déposée
M.M. & Co.

Spécialité de
Feuillards d'emballage en fer ou en acier, communs ou à charnière;
Feuillards de tonnelerie droits ou coniques;
Fer battu, qualité Extra best, pour fers à cheval.
Rondelles en fer pour tous les emplois.

INDIARUBBER MANUFACTURES.
THE
NORTH BRITISH RUBBER COMPANY
(LIMITED), OF EDINBURGH,
Are extensive and bona-fide Manufacturers of Indiarubber Furnishings for
TEXTILE MANUFACTURERS, CHEMICAL MANUFACTURERS, ENGINEERS, CONTRACTORS, DYERS, PAPER MAKERS, MILLERS, &c., also for STEAMSHIPS, RAILWAYS, COLLIERIES, IRONWORKS, and for AGRICULTURAL PURPOSES, &c., &c.
Warehouses.—London: 4, CANNON STREET.
Manchester: 6, CHARLOTTE STREET.
Glasgow: 13, Oswald Street.

THE RAILWAY
WHEEL AND AXLE WORKS COMPANY,
STOURBRIDGE.
MANUFACTURERS OF WROUGHT AND CAST IRON BOSS
RAILWAY WHEELS AND AXLES.
ALSO FORGINGS AND CASTINGS.

H. AUGUSTUS GUY AND COMPANY,
Government Contractors and Medallist
STEEL CONVERTERS AND REFINERS.
Sole proprietors and manufacturers of
GUY'S 'INVINCIBLE,' 'RELIABLE,' & 'MINING' TOOL STEEL.
Steel Forgings and Castings of every weight and Section.
The unequalled exellence and undeviating uniformity of these famous Brands secure an immense economy in the workshop and the mine.
Inventors and Sole Makers of the
"IMPERIAL" METAL.
An economical and efficient substitute for ordinary brass and gun metal, being much more durable and cheaper than these materials.
GUY'S "TRUE" BOILER CLEANER & FUEL ECONOMISER.
For removing and preventing incrustations in land and marine boilers. It prevents oxidation, secures a material saving in fuel, and doubles the life of the Boiler.
Chief Offices:
11, CLOAK LANE, CANNON STREET, LONDON, E.C.
WORKS.—The "Imperial" Metal and Steel Works Peckham, London, S.E., and Sheffield.
Full descriptive price Lists on application.

JOHN SPENCER AND SONS.
NEWBURN STEEL WORKS, NEWCASTLE-ON-TYNE,
SPRINGS, BUFFERS, STEEL CASTINGS, FORGINGS, TOOL STEEL, FILES, SPRING STEEL, SIEMENS STEEL BLOOMS & BARS

J. VEITCH WILSON AND CO'S
SPECIAL LUBRICATING OILS.
CYLINDER OILS,
POLAR OILS,
CLIMAX OILS,
Combine Efficiency, Safety, and Economy.

Samples, prices, and further particulars, on application.
Office: 5, ST. VINCENT PLACE, } GLASGOW.
Works: 258, DOBBIE'S LOAN }

Patents.—"Patent Law in PLAIN ENGLISH." By W. P. THOMPSON, C.E. 1878 Edition. British portion, 6d.; all countries, 2s. 6d.

Published by W. P. THOMPSON and Co., Patent Solicitors and Negotiators for the Sale of Patents in all countries, 323, High Holborn, London, and 6, Lord Street, Liverpool. "It is the handiest synopsis of the subject we have seen, and we commend it to the notice of every intending patentee."—IRON.

"Machinery Market."—A Monthly Business Journal. Everyone using Machinery, selling Machinery, buying Machinery, or interested in Machinery in any way should see "The Machinery Market." Single copy post free, 6d. Publishers and Proprietors—JAMES WADHAM, Sen., and Co., Darlington (England).

B. & S. MASSEY, MANCHESTER,
PATENT
STEAM HAMMERS,
Received the ONLY Prize Medal, Paris, 1878.
60 to 100 usually in Construction.
HASSE'S PATENT
POWER HAMMERS,
The best Friction Hammer made.

Wales and West of England.
The Leading Daily and Weekly Newspapers, and the Great Advertising Media.

SOUTH WALES DAILY NEWS. Published every Morning.—Price 1d.

CARDIFF TIMES AND SOUTH WALES WEEKLY NEWS.
72 Columns. Published every Friday Morning (Second Edition on Saturday Morning).—Price 2d.

The SOUTH WALES DAILY NEWS is one of the Largest Daily Papers in Wales and the West of England. It has a very large and constantly increasing circulation, and is distributed throughout an unsually extensive area, which comprises:—Glamorganshire, Monmouthshire, Carmarthenshire, Pembrokeshire, Cardiganshire, Breconshire, Radnorshire, Forest of Dean, Bristol, Gloucester, Hereford, and the West of England. The SOUTH WALES DAILY NEWS circulates in every Town and Village of this immense district, and it is unsurpassed as a General Advertising Medium—particularly for communicating with the Commercial, Mining, Manufacturing, Shipping, and Agricultural sections of the community.

The CARDIFF TIMES & SOUTH WALES WEEKLY NEWS has for over twenty years been the recognised head of the Weeky Press of Wales. It consists of seventy-two long columns, and is one of the Largest News-Sheets in the Kingdom. It has a very large and continually increasing circulation, and is published throughout the same extensive district as the South Wales Daily News.
Proprietors: D. DUNCAN AND SONS.
Chief Offices: CARDIFF.

Iron and Steel, a Work for the Forge, Foundry, Factory, and Office, containing ready, useful, and trustworthy information for Ironmasters and their Stocktakers; Managers of bar, rail, plate, and sheet rolling mills; Iron and Metal Founders; iron ship and bridge builders; mechanical, mining, and consulting engineers; architects, contractors, builders, and professional draughtsmen. By CHARLES HOARE. Eighth Edition, revised, and considerably enlarged. Pocket size, 400 pp., bound in leather, with elastic band, 6s. (postage 3d.).

"Of invaluable service to heads that devise and hands that work in the forge, foundry, factory, or office."—*Iron Trade Circular* (Ryland's.)

CROSBY LOCKWOOD & Co., 7, Stationers' Hall Court, London, E.C.

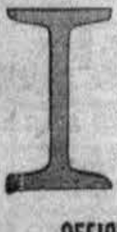
IRON TRADES' COMPANION.
Price 9s., strongly bound in leather (postage 4d.)
The Iron and Metal Trades' COMPANION: Being a Series of Tables upon a new plan for expeditiously ascertaining the value of goods bought or sold by weight, from 1s. per cwt. to 112s. per cwt., and from one farthing per pound to 1s. per pound. Each table extends from one pound to 100 tons. To which are appended many useful Rules, Tables, and Memoranda. By THOMAS DOWNIE.

"Handy and convenient, and the arrangement, to our mind, is in advance of its predecessors."—IRON.

CROSBY LOCKWOOD & Co., 7, Stationers' Hall Court, London, E.C.

ROLLED MALLEABLE IRON JOISTS AND GIRDERS.

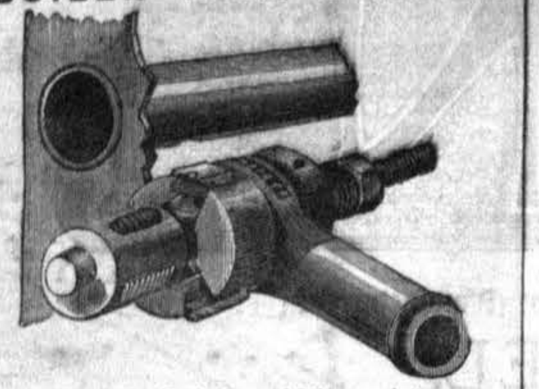
HENDERSON AND GLASS,
IRON MERCHANTS, LIVERPOOL,



Have always on hand a large Stock of **ROLLED MALLEABLE IRON JOISTS and GIRDERS** of all sizes up to 20 Inches deep and assorted lengths; also, all other descriptions of **Iron for Engineers, Boiler Makers, Shipbuilders, &c., in Bars, Plates, Bulb Iron, Angles, Tees, Jackstay Channel, Hoops, Sheets, Rods, &c. Iron and Brass Boiler Tubes.**

SPECIAL QUOTATIONS FOR SPECIFICATIONS.
Section Sheets, &c., on application.
OFFICES AND WAREHOUSES, 18, 20, AND 22, VULCAN STREET.

D. L. SELKIRK'S
BOILER TUBE BEADER.



For further Particulars and Prices, apply to
D. L. SELKIRK,
CONSULTING MARINE ENGINEER AND SURVEYOR,
9, LONDON STREET, LONDON, E.C.

HEPBURN AND GALE,

TANNERS,
LONG LANE SOUTHWARK, LONDON
MANUFACTURERS OF WIRE-SEWN AND OTHER
Leather Machine Bands.
LEATHER HOSE PIPES
Cups and Hydraulic Leathers, Prepared Hide Laces, Strap Butts, Sole Butts, Pipe Butts.

Their **Waterproof Leather** for **Pump Buckets** retains its shape, and remains perfectly solid in water. It is in general use in Mines and Collieries, and may be had of all Dealers in Leather. Each Butt bears the following stamp.

HEPBURNS'
PUMP LEATHER
WATERPROOF

Prize Medals for 1851, 1855, and 1862.

J. B. TREASURE and CO.

INVENTORS OF THE IMPROVED
FIRE-POLISHED GAUGE GLASSES
FOR
High-Pressure Steam Boilers.

8, VAUXHALL ROAD,
LIVERPOOL.

BEST FOUNDRY COKE.

Pease's West (Durham) ... ... 38s. per ton, delivered.
Special Quotations for Barge Loads.
Apply to J. T. Keene, 455, New Oxford Street, W.C.

WHITTLE & SON'S
PATENT GAS-OIL LAMP,

For Lighting Towns, Railway Stations, Ironworks, Collieries Iron Mines, Ferry Landings, &c.

The Burner vapourises the Oil, converting it into Gas, at a cost of less than one farthing per hour, giving a light fully equal to coal-gas.

One supply of Gas Oil will burn about 45 hours, a cost of ninepence.

No Wick; no Chimney; no Trimming; no further attention after once lighting.

Contracts taken for Public Lighting.

It gives a clear and very brilliant light without smoke or smell, and is in use by several Railway Companies, Iron and Steel Works, and Collieries, &c., in this country and abroad.

It is also being adapted for Town Halls, Assembly Rooms, Churches, &c.

Address Sole Makers—
WHITTLE AND SON, WHITEHAVEN.

SAM'S PATENT
DOUBLE-ACTION BOILER FEEDER,

Is much less costly than a Donkey Pump, and equally reliable.

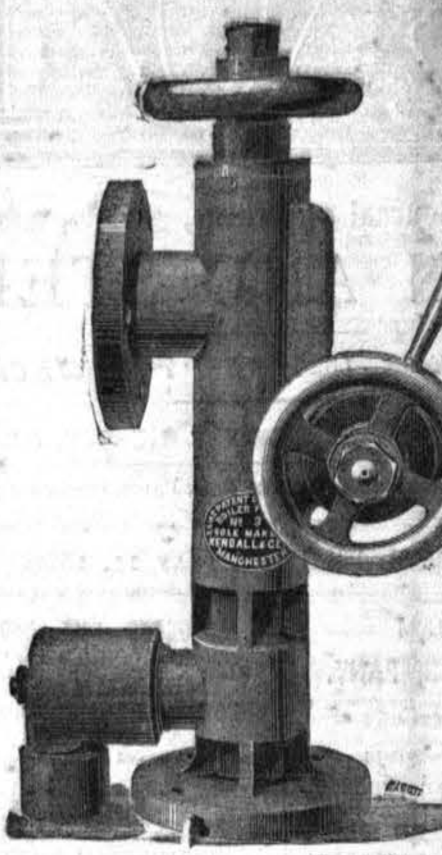
Will work with various variable stem pressure, and with water supply at a high temperature.

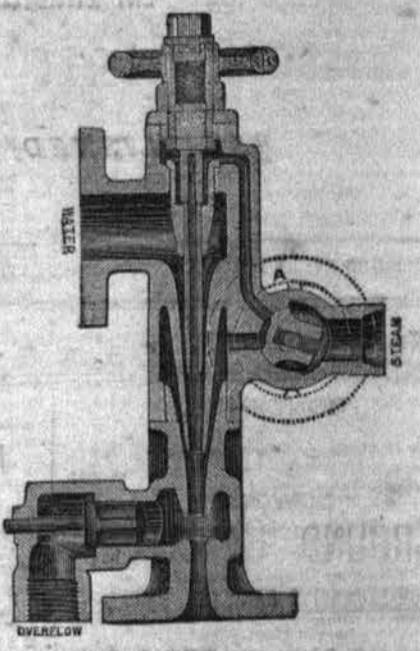
Admits of the feed being regulated according to requirements.

Has no stuffing boxes or joints entailing constant renewal of packings.

Can be examined internally throughout without removal or disconnection of a single joint.

So simple and easy to work that any unskilled person can put it in operation; indeed, in this respect, as well as certainty to continue in action without further attention until stopped, it is unequalled.


SAM'S PATENT BOILER FEEDER SOLE MAKERS KENDALL & GENT MANCHESTER



KENDALL AND GENT,

VICTORIA WORKS, SPRINGFIELD, SALFORD, MANCHESTER

Applications for Agents for this useful and economical appliance will be gladly received, the names and addresses of good houses being advertised if desired. Agents for London and district, T. E. D. Plinn, 4, Queen Victoria Street. Agents for Sweden, E. Andrew and Co., Gothenburg.

ESTABLISHED 1860
WHITTAM'S STANDARDS
MANUFACTURER OF EVERY KIND OF STEEL RULES.
STANDARDS. SQUARES. WHEEL SECTORS, &c.
25, ISLINGTON ST, SALFORD, MANCHESTER.

GOLD MEDAL, PARIS EXHIBITION, 1878.
THE HANCOCK INSPIRATOR

NEW COMBINED
PUMP AND INJECTOR.

Eclipses all other appliances hitherto introduced for feeding Steam Boilers.

Traction and Portable Engines are not perfect without them. It lifts its water 25 feet with a low steam pressure, and puts it directly into the Boiler. No adjustment necessary for varying steam-pressures.

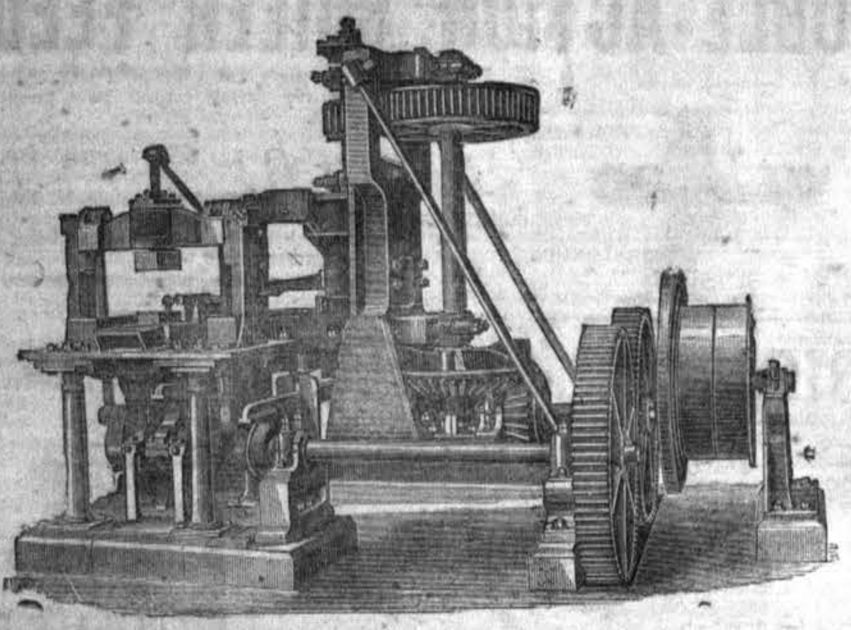
Invaluable on board large Steamers, Steam Launches, Tug Boats, &c.

No sudden jolt, nor the rolling and pitching of a vessel, will stop its action. As all other objectionable features in the ordinary form of Injectors are hereby overcome, it is an economical combination at once simple, and of guaranteed efficiency.

Full Particulars and Price Lists sent on application to the

HANCOCK INSPIRATOR COMPANY,
35, Queen Victoria Street, London, E.C.

CRAVEN'S PATENT BRICK MACHINE.



The above Machine, recently introduced, is the result of 30 years' experience in manufacturing Machinery of this class. By its action the clay is first pugged, then moulded under considerable pressure, and on delivery from the mould table the bricks are again powerfully pressed before removal, when they are ready for placing direct in the kiln, thus embracing all the advantages of the semi-dry making, and at the same time the quality produced is that of the best plastic made and pressed brick.

MANUFACTURED BY

BRADLEY AND CRAVEN,

WESTGATE COMMON FOUNDRY, WAKEFIELD.

Also Manufacturers of all kinds of BRICK and TILE-MAKING MACHINERY, CLAY MILLS, STEAM ENGINES and MINING MACHINERY.

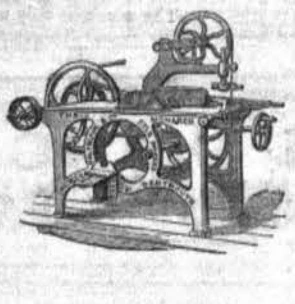
SOLE AGENT: H. CHAMBERLAIN, BRICK WORKS, BARNSLEY.

POLYBLANK & CO.,

SOUTH DEVON IRONWORKS, NEWTON ABBOT,

Manufacturers of

NEW PATENT PRIZE MEDAL



BAND SAWING MACHINERY.

A. H. BATEMAN & CO.,

East Greenwich, London, S.E.,

Also at BIRMINGHAM and MANCHESTER.

ENGINEERS AND EMERY WHEEL MAKERS.

Ransome's Patent Emery Wheels
Emery Wheel Machines for Bench or otherwise
Tool Grinders
Saw Sharpeners
Long Knife Grinders
Pulley Grinders.
&c.

No. 2. CLIMAX EMERY GRINDER.

Cyclops Patent Forges and Fans. Blowers for hand or power
Sentinel Safety Valves
Lock-up Safety Valves
Water Gauges, Fusible Plugs
Metaline Bearings
&c.

R. S. NEWALL & Co.,

SOLE PATENTEES OF UNTWISTED WIRE ROPE

Beg to call attention to their superior made Iron and Steel WIRE Ropes, for Colliery and Railway purposes; also for Capstans, Guide Ropes, Suspension Bridges, &c.

Ships' rigging supplied and fitted by experienced workmen to order, Pulleys made expressly for their Ropes. Patent Springs for ditto. Fencing Strand, Lightning Conductors, &c.

MANUFACTORY .... Gateshead-on-Tyne.
LONDON .... 130, Strand.
GLASGOW .... 68, Anderston Quay.
LIVERPOOL.............................. 36, Waterloo-road.

S. E. NORRIS & CO.,

56, 57, 58, SHADWELL, LONDON, E.

Manufacturers of

LEATHER MACHINE BANDS.

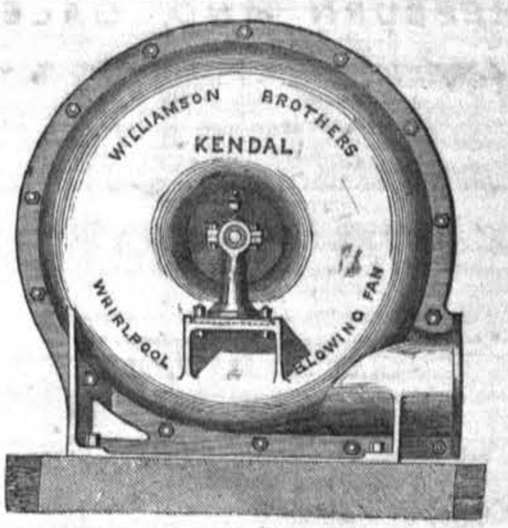
ENDLESS BANDS for Portable Engines.

WIRE-SEWN BELTING

HELVETIA LEATHER BELTING AND Leather Delivery and Suction Hose, for Fire Engines and Ships use; Pumps and Hydraulic Leather.

MILL BAND & HOSE PIPE BUTTS.

Indiarubber Hose, &c.



BLOWING FANS,

FOR CUPOLAS OR SMITHS' WORK.

These Fans are strong, well made, and require the least power to give any required blast.

CENTRIFUGAL PUMPS.

VORTEX TURBINES,

The best means of utilising water-power.

STEAM ENGINES, CORN MILL MACHINERY,

Illustrated price lists on application.

WILLIAMSON BROTHERS,

CANAL IRONWORKS,

KENDAL.

Martin and Son, Engineers, Iron Brass, and Malleable Iron Founders, Vine Street, York Road Lambeth.

Horizontal Engines, Lathes, Drilling Machines, Silent Fans, Blocks, Couplings, Shafting, Copying and Stamping Presses, Band-Fly, Spur, Bevel, Cone, and Tram Wheels, Points, Curves, Crossings, Axle Boxes, Brasses, and General Castings, Malleable Iron Lathe Carriers, Screw Stocks and Spanners.

JOSEPH GILLOTT'S
STEEL PENS.

Sold by all Dealers throughout the World.

HICKMAN & CLIVE
BIRMINGHAM.
COFFIN FURNITURE
FOR THE WORLD'S MARKETS.

MOORE & MANBY.

DUDLEY.

London Offices;

BILLITER SQ., FENCHURCH ST., C.E.

Contractors to Her Majesty's Government and the Council of State for India.

REGISTERED TRADE MARKS.

[illegible] SAXON

All Descriptions of Manufactured Iron of best qualities, viz., Bars, Hoops, Sheets, Boiler and Ship-plates, Angle, Tee, Bulb, and Beam Iron, Nail Rods, Fencing and Telegraph Wire, Rails and Railway Materials of all kinds, Pig-iron, Tin-plates, &c., &c., &c.

BICKFORD'S PATENT SAFETY FUSE

For Conveying Fire to the Charge in Blasting Rocks, &c.,

Obtained the PRIZE MEDALS at the "ROYAL EXHIBITION" of 1851; at the "INTERNATIONAL EXHIBITIONS" of 1862 & 1874, in London; at the "IMPERIAL EXPOSITION," held in Paris, 1855; at the "INTERNATIONAL EXHIBITION," held in Dublin, 1865; at the "EXPOSITION UNIVERSELLE," held in Paris, 1867; at the "GREAT INDUSTRIAL EXHIBITION," Altona, in 1869; at the "EXPOSICION NACIONAL ARGENTINA" in Cordova, S. America, in 1872, and (TWO MEDALS) at the "UNIVERSAL EXHIBITION" in Vienna, 1873, &c.

BICKFORD, SMITH & CO.,

TUCKINGMILL, CORNWALL,

AND

ST. HELEN'S JUNCTION, LANCASHIRE

MANUFACTURERS AND ORIGINAL PATENTEES OF

PATENT SAFETY FUSES,

Having been informed that the name of their firm has been attached to Fuses not of their manufacture, beg to call the attention of the Trade and Public to the following announcement:—

Every Coil of Fuse manufactured by Bickford, Smith & Co. has **Two Separate Threads** passing through the Column of Gunpowder, and they claim such **Two Separate Threads** as exclusively their Trade Mark.

MEMORANDUM FOR GAS COMPANIES.

TORBAY AND DART PAINT CO.

(LIMITED).

Sole Proprietors and Manufacturers of

WOLSTON'S

TORBAY PAINTS.

Offices—23, Great George Street, Westminster, London, S.W.

Works — Dartmouth and Brixham, Devon.

TRADE MARK.

These celebrated Paints are now very generally acknowledged to be the best and most economical in use. Gas Companies especially have, by experience, proved that no others so fully meet their peculiar requirements, as they are not only unaffected by great heat and effectually resist Sulphuretted Hydrogen, Ammonia, &c., &c., but they may be applied to Gasholders that have hitherto been covered with the unsightly coal tar. They are also cheaper than other paints and compositions; two coats of genuine Wolston's Torbay Paint being equal in covering power to three of lead paint, or any of the numerous low-priced spurious oxides that are now in the market, whilst the durability of Wolston's is unrivalled.

The colours most approved for Gasholders, Purifiers, Scrubbers, and all the plant and machinery used in and about Gas-Works, are—

For Dark Tints.

No.		per Cwt.	No.		per Cwt.
13.	Torbay Red	34s.	8.	Bronze Green	36s.
6.	Dart Brown	34s.	16.	Torbay Chocolate	34s.
10.	Carriage Red	34s.	4.	Brixham Black	32s.
1.	Torbay Brown	30s.			

For Light Tints.

No.		per Cwt.	No.		per Cwt.
7.	Imperial Stone	34s.	19.	Light Stone	36s.
29.	Portland Stone	38s.	30.	Bath Stone	38s.
31.	Gray Stone	38s.	38.	Buff	35s.

These Prices are for Paints in paste, carriage paid to any Gas-works in Great Britain, in consignments of not less than 5 cwt.; but all the above colours may be had, ready mixed for the brush, in various-sized paint cans with handles at a uniform price of 56s. per cwt. (6d. per lb.) carriage paid as above, in consignments of not less than 2 cwt., the sizes being 3 lb., 7 lb., 14 lb., and 28 lb. By taking the Paints in this convenient form, a considerable saving is effected in time, &c., as they can be immediately applied by any workman without the intervention of skilled painters to mix and prepare them; besides which all waste is avoided, and they may always be relied on as containing no adulterating or inferior material.

Where light colours are preferred, the works should be primed with two coats of No. 7, and finished with either of the other stone colours; and when the dark colours are selected, a priming coat of No. 13 is recommended.

Specimen Cards forwarded and Inquiries attended to on application to

23, GREAT GEORGE STREET, WESTMINSTER, LONDON.

ESTABLISHED 1832.

JAMES EADIE AND SONS,

(Formerly EADIE and SPENCER),

CLYDESDALE TUBE WORKS,

RUTHERGLEN, near GLASGOW,

MANUFACTURERS OF

LAP-WELDED IRON BOILER TUBES,

Iron Tubes, with Copper Ends brazed on, specially adapted for Locomotive Boilers.

Sole Agents for London and District:

JOHN C. ANDERSON, 114, FENCHURCH STREET, E.C.

THE STEEL COMPANY OF SCOTLAND, LIMITED,

(SIEMENS' PROCESS),

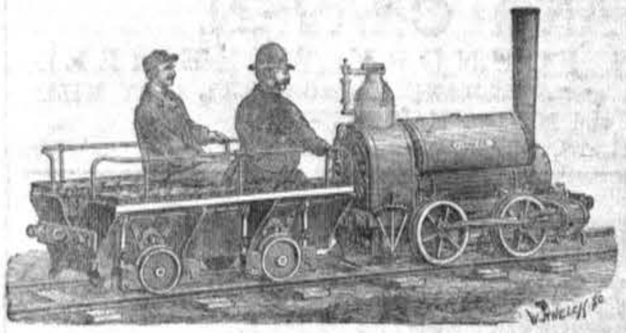
150, HOPE STREET, GLASGOW,

MANUFACTURERS OF

STEEL RAILS, FORGINGS, PLATES & CASTINGS.

RANSOMES & RAPIER, ENGINEERS,

5, Westminster Chambers, London.



Makers of all kinds of Machinery and plant for Heavy Railways or Light Railways.

ALSO OF

CRANES OF ALL KINDS AND SIZES

IMPORTANT IMPROVEMENTS IN PILE-DRIVERS

BRONZE MEDAL. PARIS, 1878.

LACOUR'S

Patent Direct-Acting Steam Pile Driver.

Used in the Principal Government Harbours, Docks, and Railways in France, Italy, and Spain.

Effects considerable saving in time and money in the operation of driving piles through hard or soft ground.

The winch is only used for placing the pile in position, the monkey being operated by steam direct from the boiler.

The monkey can be readily fitted to the frame of an ordinary Pile Driver.

SOLE LICENSEES and MANUFACTURERS for the United Kingdom of Great Britain,

S. OWENS AND CO.,

HYDRAULIC AND GENERAL ENGINEERS.

WHITEFRIARS STREET, LONDON, E.C.

Illustrated Pamphlet and Price List Free.

VULCANISED FIBRE,

PATENTED.

The **FLEXIBLE** is a Substitute for **Leather, Rubber, Gutta Percha**, &c., and is extensively used by **Plumbers, Brass Founders, Axle Makers, Hydraulic, Sanitary**, and other **Engineers. Railway Companies, Carriage Builders, Pump Makers, &c.**

It makes the best insertion sheet, and for axle-washers of all kinds it is unequalled.

Mr. George Howe, Engineer at the Clay Cross Collieries, says:—

> "That a pump clack faced with Vulcanised Fibre one half inch thick, was put into work January 13th, 1879, and was taken out July 3rd, 1879, having been in work 171 days. During this time the pump made 741,827 strokes, and raised 74,182,700 gallons. The clacks were previously used with leather facings; these only lasted in work about 40 days; when faced with gutta percha, they last in work about 150 days, but gutta percha is 5s. per lb., whereas the fibre is only 2s."

The **HARD** is a Substitute for **Metals, Ivory, Vulcanite, Ebony**, &c., and is used for **Journal Bearings** and **Bushes, Condenser Ferrules, Railway Fish-plate Washers, Pneumatic Carriers, Electric Machines, &c.**

Mr. T. A. Edison, the great electrician, writes:—

> "I esteem it very highly, and use larger quantities of it than Vulcanised Rubber, and, in its present condition, find it very satisfactory."

Both qualities of the Vulcanised Fibre are uninjured by the action of Hot and Cold water, oils spirits, grease, ammonia, and many other chemical agents which utterly destroy leather, metals and rubber.

Sold in sheets about 66 inches by 42 inches and varying in thickness from 1-32 to 1 inch.

SOLE AGENTS:—

MOSSES AND MITCHELL, 62, Queen Victoria Street, London, E.C.

BRAY'S PATENT LANTERN & FLAT-FLAME BURNERS.

THE FLAT-FLAME IS THE ONLY PRACTICABLE SYSTEM FOR STREET LIGHTING;

and, "in actual use," yields as much light with Common Gas, and more light with Cannel Gas, than any Argand System.

IMPORTANT NOTICE.

HAVING some time ago dealt with Mr. Sugg's statement that his street-lighting apparatus yielded "over 30 per cent." more light "over all others" in the market, in a manner that caused its prompt withdrawal, we had hoped that the necessity would not have again risen to defend ourselves against statements calculated to mislead Lighting Authorities and the Public.

At the Exhibition of Gas Lamps, recently held at Birmingham, an error in Mr. Sugg's favour—admitted to be such by the Experimenters, and known to be such by all those who have had to do with making comparative tests with these Lanterns—having been made in the test with the 200-candle power Lantern, it has been extensively advertised, without the correction accompanying it in Mr. Hunt's Report.

A correct estimate of Mr. Sugg's fresh advertisement will be gathered from the following facts, which he has been careful NOT to publish:—

1. Mr. Sugg has NOT noticed Bray's 80-candle high lighting power Flat-flame, which Mr. Hunt tested along with the other burners we sent, and which Mr. Sugg knows to have yielded 3·51 candles per foot; and he has omitted to state that this is a higher result than that produced by either of his 80-candle Argands, which was 3·26 and 3·41 candles per foot respectively; and this without deducting the 40 per cent. that the Argand necessarily loses "in actual use" (*see paragraph* 5). A large proportion of the street-lighting apparatus sent out by Mr. Sugg are 80-candle power, and have been freely advertised as yielding "over 30 per cent. more light than all others," &c.

2. Mr. Sugg does NOT state that all Bray's burners, with which he compares his own, in his advertisement, are of "MEDIUM lighting power," known to be such by the Birmingham authorities, and by Mr. Sugg, and distinctly stated to be such in all our lamp sheets. Therefore, in comparing his HIGH lighting power with our MEDIUM lighting power burner, without stating the fact, he takes an unfair advantage of a competitor, and the public are misled.

3. Mr. Sugg does NOT point out that there is but one (and that the least used) of the Argand, which he names, which shows a superiority of even 12 per cent. over Bray's above-mentioned 80-candle power burner, and this should be corrected as per paragraph 5.

4. Mr. Sugg does NOT mention that the Flat-flame Burners he exhibited were beaten by Bray's 80-candle power Flat-flame to the extent of 8 per cent. in one test, and 12 per cent. in another, but he distinctly states that his Flat-flame Burners "produced the highest result in illuminating power of all Flat-flame Burners present."

5. Nor does Mr. Sugg draw attention to the fact that the Argand cannot be made to yield "in actual use" the light it shows when tested by the ordinary photometer, which is the same in principle as that adopted at Birmingham. We state—and our utmost effort has not availed us to get Mr. Sugg to contest the points with us—that the lack of top and bottom light (as compared with the Flat-flame)—reduces the total all round yield by about 20 per cent.; and that the Argand burner cannot be governed, "in actual use," to yield within 10 per cent. of its best, because of the liability of the flame to smoke with the slightest increase of pressure when working to its full capacity. And a further deduction of 10 per cenr. must be made, because of the chimney becoming rapidly dirty, and permanently opaque by use if it does not happen to break.

6. Mr. Sugg also OMITS to mention that the Lantern in which his 200-candle power burner was tested was NOT the Sugg "Shadowless," of which there have been so many sold, but one designed by Mr. Hunt, which yields a much greater amount of light.

7. And while Mr. Sugg gives prominence to a result admitted to be erroneous by the experimenters (and has not accepted our offer to make another test with the same lamps), he entirely omits to mention the correction which accompanied the report from which he professes to quote. This correction showed that, when both apparatus were rated to consume exactly 46·75 feet of gas per hour, the lights were equal when the shadow meter was 73 feet 2 inches from Bray's Flat-flame Lantern, and 76 feet 10 inches from Hunt's Improvement on the Sugg Argand Lantern—this showing a difference of only 3 feet 8 inches; and from this result allowance must be made for the defects of the Argand when "in actual use," as per paragraph 5.

In view of the above, a proper estimate will be placed on Mr. Sugg's recent declaration that he "will have nothing to do with challenges," but "will continue to give, as he has always done, correct information of the results to be obtained from his burners and lanterns."

Extract from the *Leeds Mercury*, April 1st, 1880.

"At the meeting of the Leeds Town Council, March 31, Alderman Gaunt moved that the Council approve of the acceptance by the Corporate Property Committee of the tender of Messrs. George Bray and Co. for the supply of 21 new lamps, to be placed upon the pillars round the Town Hall. The committe had tested Sugg's and other lamps, and found Messrs. Bray's the best. It was intended to have two 200-candles power and two 100-candles power, and 17 round the hall of 80-candles power. Mr. Lynd, in seconding the motion, said that he had had an opportunity of seeing different lamps tested at Birmingham, and he was in favour of Messrs. Bray's."

Extract from the *Daily Free Press*, Aberdeen, Jan. 1, 1880.

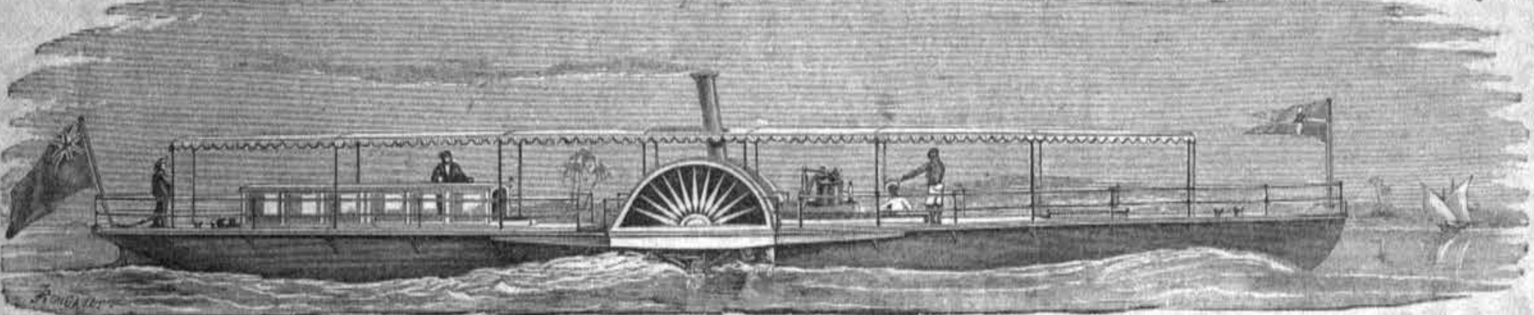
"Judging of the merits of the light as they appeared last night, on-lookers seemed to be generally of opinion that between Sugg's patent and Bray's larger light at the corner of Union Buildings, Castle Street, there was no perceptible difference in the illuminating power. When the vital question of gas consumption is taken into account, it is found that in the Castle Street lamps there is a marked difference in the quantity of gas consumed; for, while 30 feet of gas are hourly burned in Sugg's patent lamp, only 20 feet are used by Bray's lamp during the same period."

[The above Lamps have Meters attached.]

Bray's Lanterns have been adopted by the Vestry of St. George (which includes WESTMINSTER), Hanover Square, London, for all the crossings and refuges of that important district, after a direct competition with the Argand system of lighting; and also by about 40 towns and vestries, after a similar competition in most cases.

GEORGE BRAY & CO., Blackman Lane, LEEDS.

YARROW'S SMALL STEAMERS, YACHTS & LAUNCHES (Wood, Iron or Steel.)



SCREW STEAMERS HAVING SPEEDS UP TO 26 MILES AN HOUR.

PADDLE STEAMERS HAVING DRAUGHTS DOWN TO 6in. OF WATER.

MACHINERY CONSTRUCTED FOR BOATS BUILT ABROAD.

YARROW & CO. (late Yarrow & Hedley), Engineers & Shipbuilders, ISLE OF DOGS, POPLAR, LONDON.

SMITH & COVENTRY

Makers of PATENT SPECIAL and GENERAL MACHINE TOOLS of all Descriptions.

MANUFACTURERS OF

STRAIGHT LIP TWIST DRILLS.

OF THE HIGHEST QUALITY, WITH GRINDING LINE. A LARGE STOCK ALWAYS READY FOR DELIVERY.

GRESLEY IRON WORKS, ORDSAL LANE, SALFORD, MANCHESTER

LONDON OFFICE: 46, FISH STREET HILL, E.C., W. PARSEY, Agent, where the TWIST DRILLS may also be obtained from Stock.

CLIVE AND COMPANY,

MANUFACTURERS OF

STEAM & HYDRAULIC ENGINE PACKINGS

WORKS—SUFFOLK GROVE, SOUTHWARK, LONDON, S.E.

SPECIALITIES.

Improved Patent Self-Lubricating TALC and GLYCERINE PACKING, adapted for High Pressures. Improved Patent. Self-Lubricating Dry TALC Packing.

Any description of Cotton or Hemp Packing (either round or square) made to order for SHIPPERS AND LARGE BUYERS.

SAMPLES AND PRICES ON APPLICATION.

THE SAVILE STREET FOUNDRY & ENGINEERING COMPANY, LTD., SHEFFIELD,

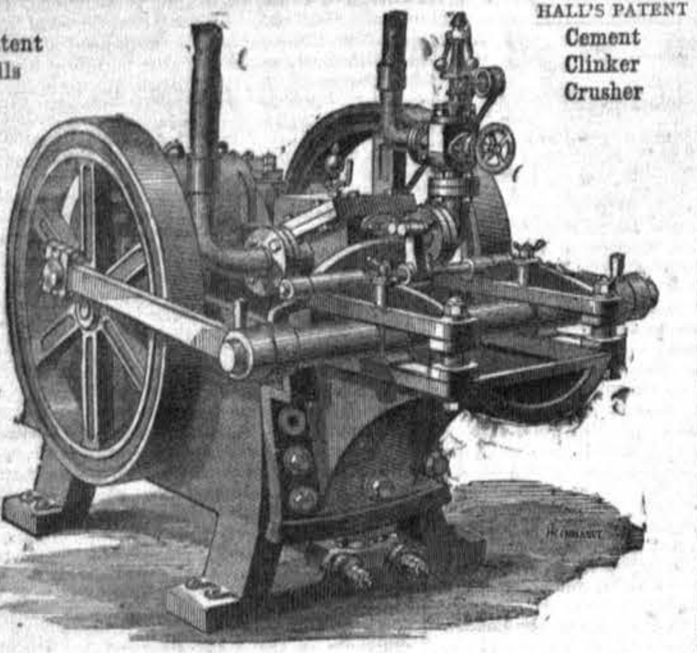
MAKERS OF

HALL'S PATENT DIFFERENTIAL GEARED BONE MLLS.

HALL'S MULTIPLE ACTION STONE-BREAKER AND ORE CRUSHER.

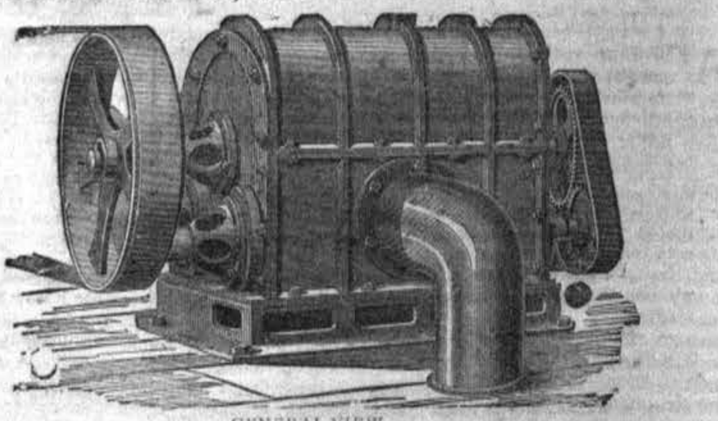
Hall's Patent
Bone Mills

HALL'S PATENT
Cement
Clinker
Crusher



ENGINE AND MACHINE COMBINED.

BAKER'S ROTARY PRESSURE BLOWER GAS EXHAUSTER and VENTILATOR, BAKER'S ROTARY PUMP, &c.



GENERAL VIEW.

This Blower is adapted for Cupolas, Smiths' Fires, Ore Hearths, Slag Hearths, Refineries, &c., &c., also for Ventilating Coal and other Mines, Ships, Buildings, Railway Tunnels, Drying Rooms, and generally for elevating Grain, Timber, Sugar, &c.

ITS ADVANTAGES ARE

Fewness of parts—Less pulsation than any of its class—Capability of running direct from an Engine—Not being affected internally by wearing of gears—Requiring no lubrication internally, and no dubbing to make it temporarily tight—Exhausting as well as blowing—Non-injury from dust—Steady running, without jerking belts—Unchangeability in power from damp—Blowing hot and cold equally well—Small power required for amount of air discharged—And entire absence of friction internally.

QUARRYING MACHINE.

TUNNELLING MACHINE

Hand Power Rock Drill Company, Ltd.

FOR THE
LATEST TESTIMONIALS AND REPORTS
OF PRACTICAL WORK
APPLY TO

T. B. JORDAN, SON AND MEIHE,

52, GRACECHURCH STREET, E.C.

IF PURCHASERS ARE UNABLE TO OBTAIN THE PRACTICAL RESULTS CLAIMED FOR THIS DRILL, J. S. & M. ARE WILLING TO UNDERTAKE CONTRACTS AT SAME PRICE PER FATHOM DRIVEN AS PAID FOR HAND LABOUR, AND, FAILING TO OBTAIN RAPID ADVANCE, AND TO PROVE THE ADVANTAGES OF THE MACHINE AGREE TO TAKE IT BACK.

JORDAN'S
PATENT "DEAD-BLOW" HAND POWER ROCK DRILL

Prices, Complete, £55 to £70.

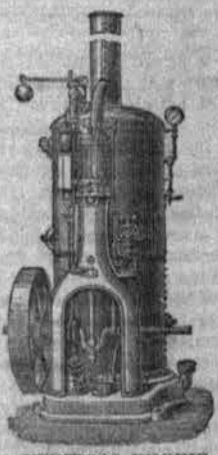
PATENT GOLD-REDUCING MACHINERY AND GENERAL MINING PLANT.

ALEXANDER SHANKS AND SON,

DENS IRONWORKS, ARBROATH,

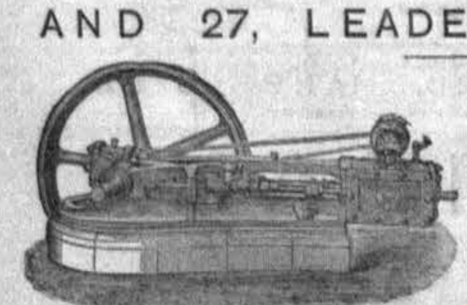
AND 27, LEADENHALL STREET, LONDON.

TRADE MARK,
NEMO ME IMPUNE LACESSET



VERTICAL ENGINE AND BOILER.

SHANKS'S PATENT HORIZONTAL AND VERTICAL STEAM ENGINES,
STEAM CRANES, HOISTING ENGINES,
DECK WINCHES,
VERTICAL, CORNISH AND LANCASHIRE BOILERS.



THE CALEDONIAN.

Horizontal and Vertical Engines and Boilers, Steam Cranes, Hoisting Engines, Deck Winches, &c., can be seen on application at 27, Leadenhall Street. Price List and full particulars sent free.

WHEATLEY KIRK, PRICE AND GOULTY, ENGINEERS, ALBERT SQUARE, MANCHESTER,
SOLE AGENTS FOR MANCHESTER AND DISTRICT.

IRON.

LONDON, FRIDAY, MAY 21, 1880.

THE TAY BRIDGE DISASTER.

AFTER a protracted inquiry, extending over several weeks and involving twenty-six sittings, the Commissioners appointed to investigate the Tay Bridge disaster, with the view of determining its cause, have adjourned their meetings *sine die*. Those of our readers who have followed our weekly reports of the proceedings—condensed though they necessarily have been—or the more detailed statements in the daily papers, cannot fail to have observed that a vast amount of evidence was given, and that a large proportion of that evidence was of a very conflicting and contradictory nature. The contradictions, however, were largely confined to matters of opinion. Matters of fact could scarcely be liable to contradiction, and these to a great extent went to show the existence of defects in the parts of the structure. It may probably be some little time before the report of the Commissioners is made public, and until that time arrives it would be highly indecorous on our part to offer any critical observations on the evidence taken, or to indicate the conclusions to which it points. Indeed, this latter course would be somewhat difficult, owing to the conflicting nature of some of the statements, as already mentioned, and which may possibly necessitate further and personal local inquiry and investigation on the part of the Commissioners before their report can be completed. Originally commenced in Dundee and continued in London, the inquiry may possibly terminate in the former town. It may be taken for granted that the investigations of the Commissioners will be of the most searching character, their object being to render the repetition of such an accident as that of the 28th December last, as far as they can, impossible, by bringing to light its causes.

It is well known that the bridge, up to the time of its destruction, was generally looked upon as a pattern structure of its kind and one well worthy of imitation elsewhere as occasion might require. It is no less well known that not only structurally was the bridge thus viewed but as a model of cheapness and rapid construction. As we briefly wrote on the 2nd of January last, so we now repeat, that it is impossible not to believe that those who had charge of the designing and constructing of the bridge did their best to ensure its safety. They doubtless took into consideration all the contingencies that were ever likely to affect its strength and stability; and it is in evidence that they prepared their designs accordingly, and in accordance with the best principles of modern engineering construction. The evidence of Mr. Benjamin Baker, a gentleman well qualified to offer an opinion goes to prove this very strongly. He moreover stated that he considered the workmanship of the Tay Bridge, generally, was of good character. He observed, however, that good and bad work were relative and that he had seen both better and worse work than there was in that structure. But, however correct may have been the design, and however sound the general execution, there still remains the fact that the bridge was a marvel of cheapness and of rapid construction; and it may be a question how far these two conditions have affected and influenced the character of the more minute details of the work. At the same time and in the face of the defects which are stated to have existed in some of the castings, it is in evidence that those who were responsible appeared to have been fully alive to their responsibilities and to have acted accordingly.

Then again we have it stated that inferior Cleveland iron was used in some portions of the structure, against which we have the Commissioners stating that the Court had received the results of some tests made by Mr. Kirkaldy as to the quality of the iron, and that the opinion of the Court was that the iron was exceptionally good. It appears that the wrought iron in the bolts was of excellent quality, and only broke under a strain of 25 tons per square inch, whilst the tie-bars did not give way in the eyes until a strain of 20 tons per square inch had been reached. Portions of the girders bore respectively strains of 22½ and 23½ tons per square inch before breaking, and strips cut from the broken cast-iron columns bore a direct tensile strain of 9½ tons per square inch before yielding to stress. These figures speak for themselves and for the character of the metal. Mr. Law's evidence is certainly very damaging. He reported fully on the whole construction, which he condemns *in toto*, leaving an impression not of the most pleasant nature, and one, moreover, which it is to be hoped the report of the Commissioners will tend to modify. Then, as to the Government inspection of the bridge, it is stated that that was far more carefully and closely performed than usual, and the tests showed the bridge to be far more stiff than had been anticipated. Thus, from first to last, the broad and general conditions of safety appear to have been duly regarded. It, however, remains to be seen to what extent subordinate supervision was carried, and whether sufficient attention was paid to the multifarious requirements of the structure in detail. There can be no doubt whatever that all these points will receive the fullest consideration at the hands of the Commissioners, and although the enquiry cannot recal the past, it can, and doubtless will, prove profitable in the future.

OUR TRADE SUMMARY.

THE effect of the Whitsun holiday season has been, as was to be expected, to increase the slackness that has for some time affected most departments of the iron trade. The Glasgow warrant-market has been especially dull during the past week, and although prices have declined much, there is still a downward tendency perceptible, owing most likely to a feeling that the demand for pig-iron is not likely soon to overtake the supply. The investment by the outside public continues, and holders are willing to sell. The closing prices on Wednesday were 45s. 9d. for cash, and 45s. 10½d. a month; sellers, as usual, 1½d. per ton more. Production still goes on at about the same rate, the number of furnaces in blast being 113 as against 87 at the corresponding period last year. There is very little doing by makers, and several brands are offering at a reduction. The malleable iron manufacturers are also badly off for orders, and low prices are being taken to secure contracts; but buyers hold back in expectation of a still further decline. The shipbuilders and engineers are, however, fairly well employed, as are also the forges, but the founders are less so. At Middlesborough on Tuesday the Exchange was but sparsely attended, and prices of pig, which had fallen since the previous market day, showed a continued tendency in the same direction, some lots changing hands at 36s. 6d. to 36s. 9d., the ruling quotation, however, being 37s. The finished-iron trade of the district is doing well for the present, but the look-out ahead is not over cheerful. There is an improvement in the foundry department; and the successors of the firm which supplied the iron for the Tay Bridge have received a large order for bridge material from India—a result probably of the rehabilitation which Mr. Kirkaldy's investigations have conferred on Cleveland wrought iron. The prices of pig in the Durham district, in the face of a limited demand, have remained moderately steady. Measures are, however, likely to be taken to diminish production by at least temporarily throwing some of the supplementary furnaces out of blast, the tendency being to reduce those away from the seaboard and the ironstone deposits, and ultimately to concentrate the production in the district of Cleveland proper. There is a downward inclination in the prices of manufactured, and orders are coming slowly in; although some of the larger plate manufacturers are stated to have work in hand sufficient to occupy them for some time to come. There have been large shipments of pig from the Tyne district, but there is no improvement in prices. Manufactured rates also continue low with a downward tendency; but the reduction in plates is evidently giving a stimulus to shipbuilding. In the hematite region of the north-west, makers are still busily employed on old contracts, but they are booking very few new orders. There is little doing for home consumption, but expectations are entertained, despite the gradual decline in prices, that the demand for Bessemer qualities especially will revive before long. The shipbuilding trade is active, and a number of new orders have been received. Little or no business was done at the Manchester weekly meeting on Tuesday; but the low prices of iron are stimulating inquiry to some extent. In the finished-iron trade there is no material improvement, and the continued depression in the textile trades of the district affects founders, engineers and machinists. In West Yorkshire, however, the firms noted for the production of textile machinery are becoming busier. Both in the Forest of Dean and in South Wales matters are in a far from flourishing condition. Of the local trades of Birmingham there is little favourable to report, and the kindred industries of Wolverhampton district appear only a little less unsatisfactory; but much of this is, of course, attributable to the season. The coal trade is duller than ever, although in some instances there is a little more demand for manufacturing qualities.

HISTORY OF MODERN INVENTION
IN THE
MANUFACTURE OF IRON.

BY W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

(*Continued from page* 290.)

THE BESSEMER PROCESS.—No. 10.

THE next specification of Mr. Bessemer is No. 1938, dated 19th August, 1856. Its preamble states that "the process of puddling is generally carried on in furnaces which reverberate the flame and gaseous matter evolved by the combustion of mineral coal on to the fluid or semi-fluid metal, whereby the iron is found to be more or less injured by the gaseous matters thus brought in contact with it." This was generally believed at the time, and may be still by many who have not specially investigated the action of the reverberated flame upon the melted metal in the puddling furnace. I took it for granted myself until 1868, when engaged as chemist in the works of Sir John Brown and Co. (Limited), Sheffield. Finding that several qualities of coal from different seams were used at the works, and indifferently supplied to the puddling furnaces or boiler furnaces, I set to work to determine their relative degrees of impurity as regards sulphur, in order that a selection might be made, and those containing the smallest proportion of sulphur be used for puddling. On presenting my report to Mr. Ellis I was surprised to find that he held the opinion that the sulphur of the coal used in puddling had no effect on the iron. He admitted that it was mischievous in the blast-furnace, but not in the puddling furnace. Having already seen good reason to respect his practical conclusions, I determined to test the question experimentally, and accordingly had two heats worked by the same men from the same brands of pig, but one with the best and the other with the worst quality of coal on the works as regards sulphur impurity. The results were severely tested, and no difference of quality was observable. The form in which the sulphur impurity of coal occurs is iron pyrites. I next picked out from a heap of the worst coal the lumps displaying the most abundant veins of pyrites, so as to obtain an excessively bad sample. A heat was worked with this. There was no deterioration of the puddled bar. Then I obtained some pyrites in large lumps, threw these into the furnace and worked a series of heats thus, with continually increasing quantities, until 56 lb. of pyrites was reached, the quantity of coal being 5 cwt., and that itself a sulphurous coal. I thus worked up to about ten times the amount of sulphur contained in ordinary coal. None of the results of these experiments justified the conclusion that the sulphur did any mischief. The average quality of the samples was quite equal—in fact, a little better—than those made with the best coal. The improvement of the quality was about equal to that which is usual in experimental heats, where the men get a "tip" for extra trouble.

The object of the invention described in this specification is to escape this supposed sort of mischief, and to save the coal used in puddling, by combining the puddling process with the Bessemer specialty of injecting air into the melted metal; thereby producing a malleable iron similar or superior to that turned out from the ordinary puddling furnace, and to do this with less manual labour, seeing that a part of the necessary agitation shall be done by the blowing-in of the air or steam. "Other gaseous matter containing, or capable of evolving, sufficient oxygen to raise the temperature of the metal so far as to permit of the puddling or other analogous process being carried on without the use of any fuel or heat other than is obtained by the introduction of oxygen into the metal, or by the introduction of hydrogen" in the manner described, is also claimed.

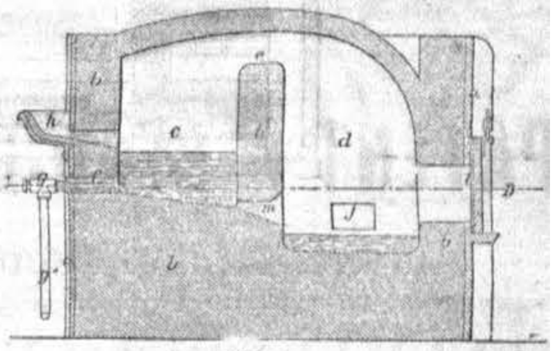


FIG. 1.

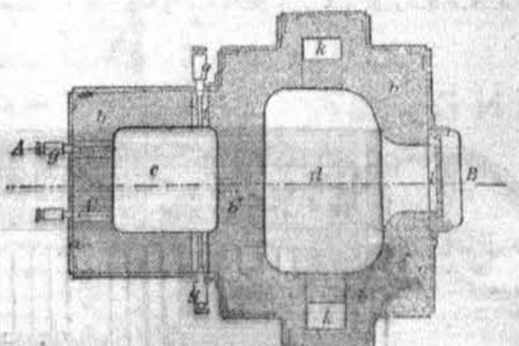


FIG. 2.

Fig. 1 is a vertical section, and fig. 2 a horizontal section of one form of furnace to be used for these purposes. Fig. 1 is taken on the line A B of fig. 2, and fig. 2 on the line C D of fig 1. The exterior shell, *a a*, is of iron plates, similar to an ordinary puddling furnace, which is lined with firebricks, *b b*.

(*Continued on page* 369.)

FRENCH DISTILLING APPLIANCES.

BY MESSRS. SAVALLE FILS ET CIE., PARIS.

(For description see page 370.)

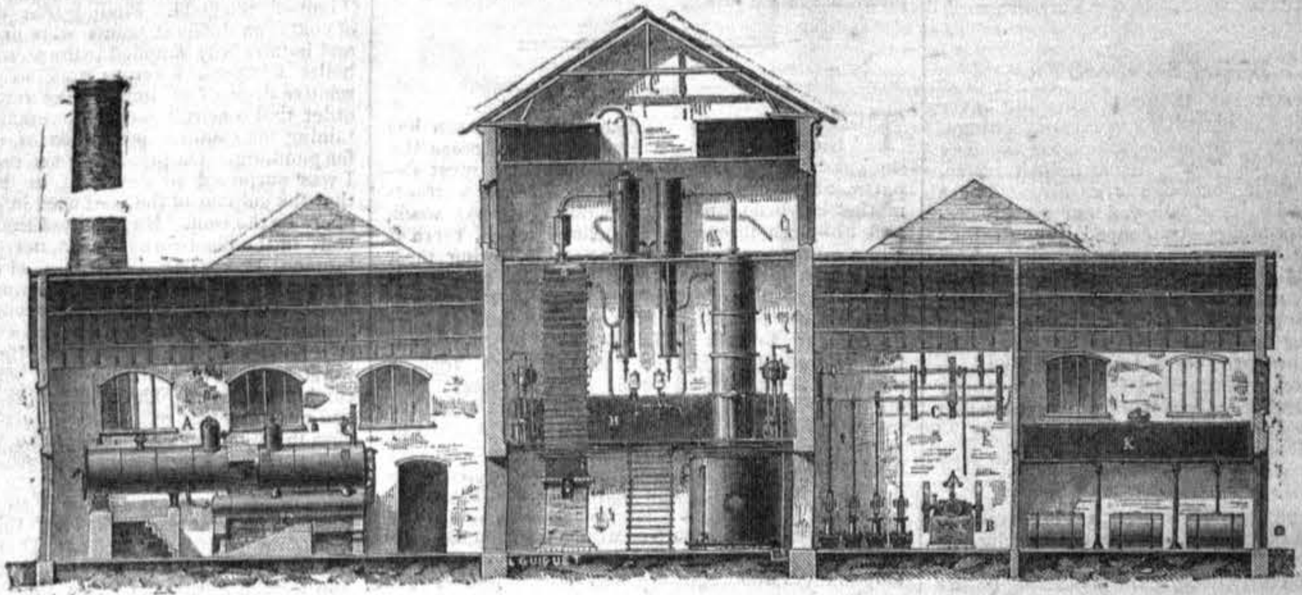


Fig. 6.

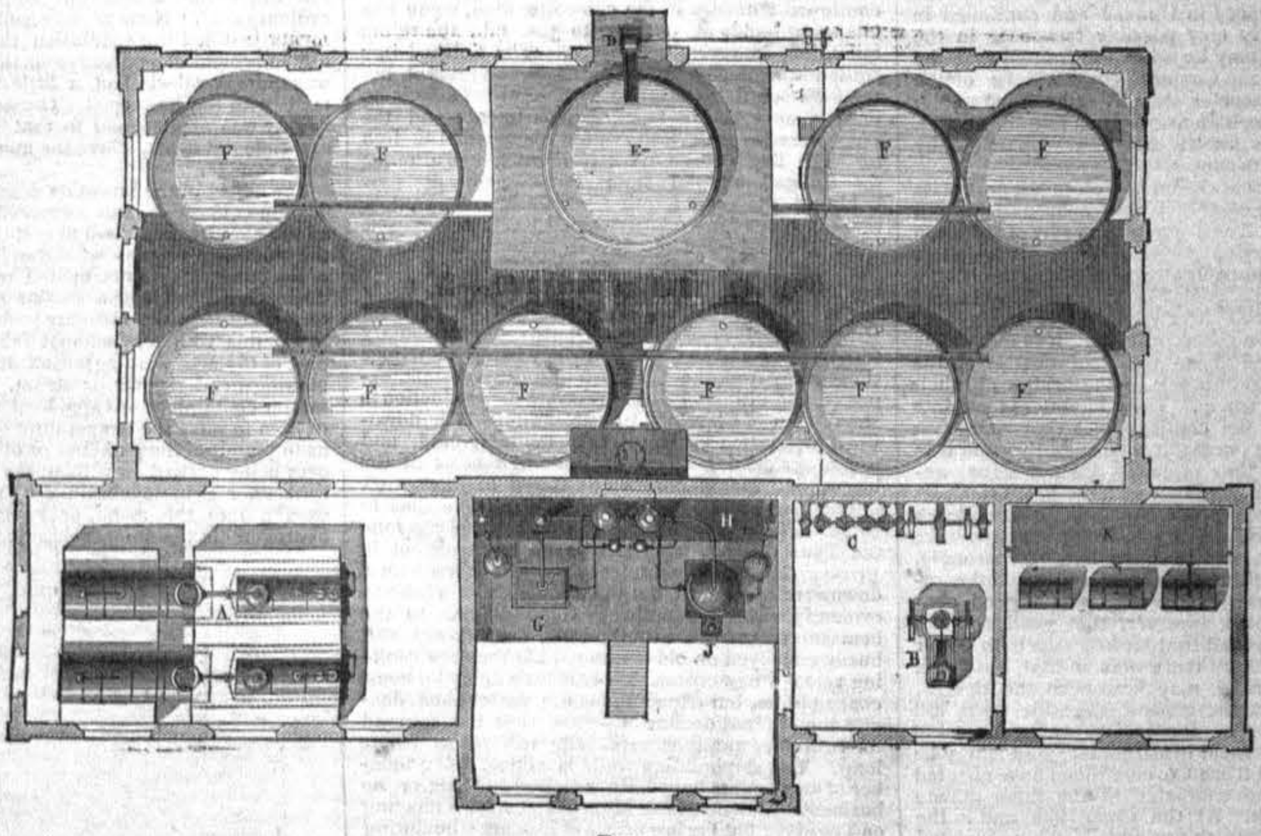


Fig. 7.

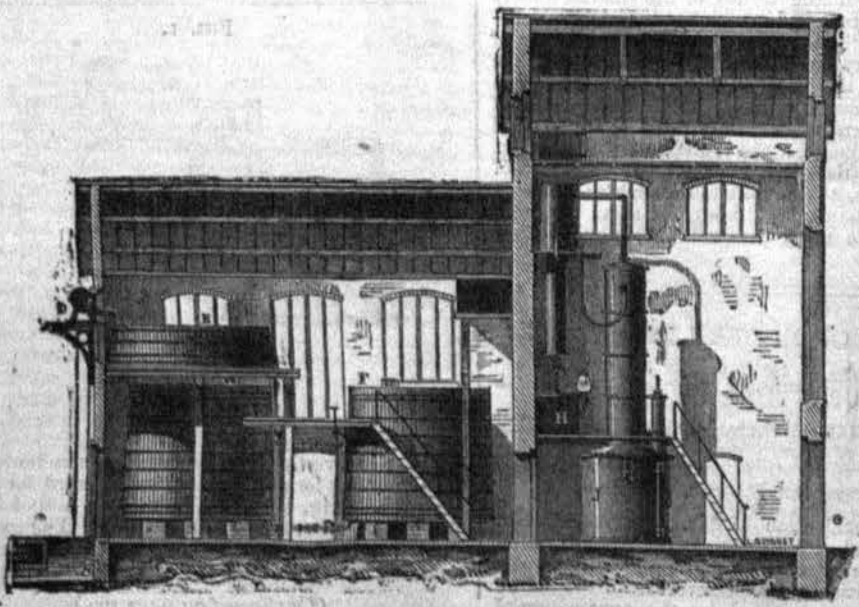


Fig. 8.

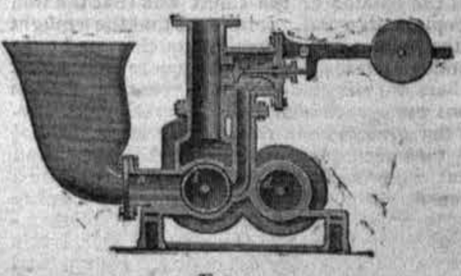


Fig. 9

FRENCH DISTILLING APPLIANCES.

BY MESSRS. SAVALLE FILS ET CIE., PARIS.

(*For description see page* 370.)

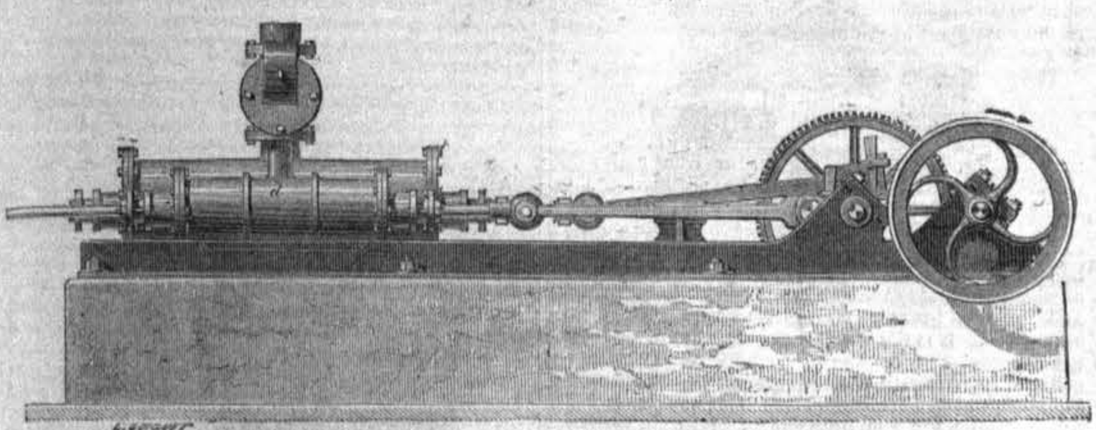


FIG. 10.

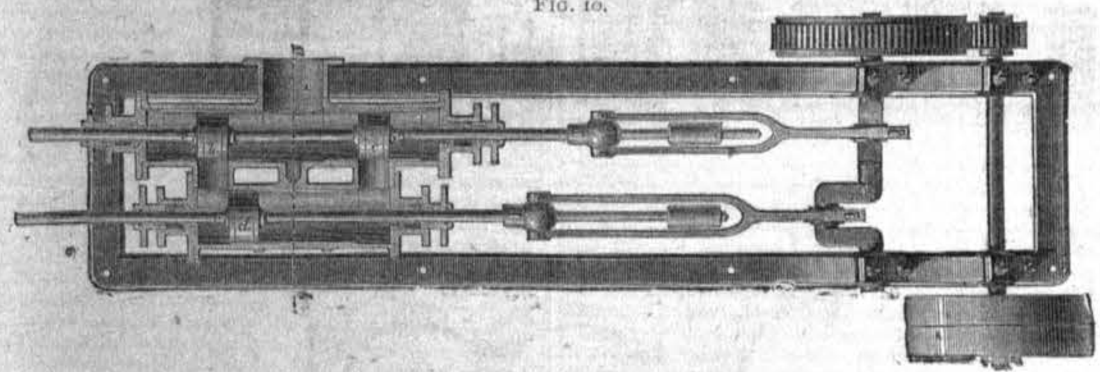


FIG. 11.

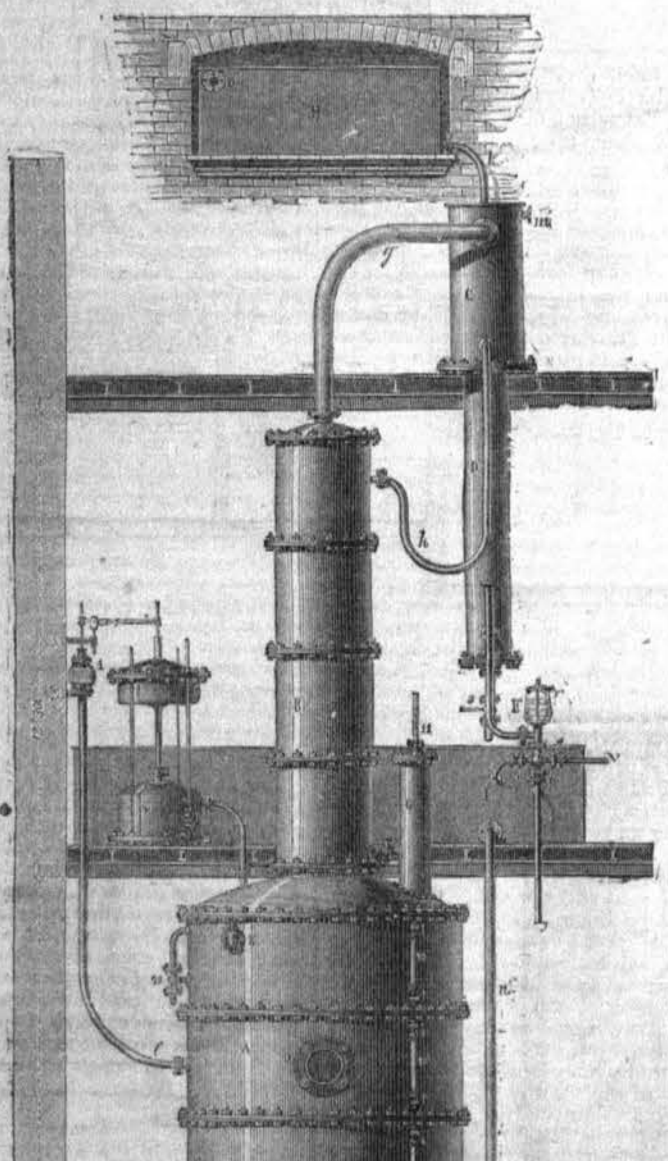


FIG. 12.

HISTORY OF MODERN INVENTION IN THE MANUFACTURE OF IRON.

By W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

(*Continued from page* 367).

The furnace is divided into two chambers, *c* and *d*, by the partition wall, *b**, but a space is left at *e*, to form a communication between the two chambers. Tuyere pipes, *f*, are inserted at the lower part of *c*, connected by *g* *g**, with the main blast-pipe. The metal is to be blown until carbon and silicon, "and some other impurities," driven off, and the temperature "greatly raised" in accordance with specification of Feb. 12, 1856. "Should the crude iron subjected to this process be known to contain sulphur, it will be found advantageous to pass hydrogen gas from time to time through the tuyeres into the metal, in order that the same may combine with the sulphur and carry it off." This may precede the decarbonisation by oxygen, while the metal is less liable to solidify than after the carbon and silicon are removed, Mr. Bessemer states that "the use of hydrogen gas will also be found useful during and after the decarbonisation of the metal by oxygen, as it will not only assist in the removal of any remaining portions of sulphur, but will also act upon and assist in the removal of the phosphorus and phosphoric acid, if the same be present in the crude metal," and further that he has observed "that the forcing of atmospheric air through molten iron so operates upon the metal, that on the completion of the process, and after the forcing-in of the air has ceased, that the metal so operated upon is in a state of ebullition, arising from the disengagement of carbonic acid or other gaseous matter ,and that the stirring or agitation of the metal greatly promotes this disengagement of gas." He therefore prefers to desulphurise by hydrogen after the oxidation, in order that the agitation may remove these gaseous matters and otherwise assist in the purification of the metal. The hydrogen "may be obtained by the action of dilute sulphuric acid on metallic zinc, or by other well-known means.".

The furnace is charged by pouring the fluid into spout *h*, and from them into the chamber *c*, the the blast having been previously turned on, and the chamber heated. Air and hydrogen may be forced in at alternate intervals, or otherwise, according to the quality of the crude iron, care being taken to avoid solidification by using the hydrogen for too long a time at the completion of the process. To avoid this the tuyere pipes, *f*, may be arranged in pairs in such wise that a jet of hydrogen may be forced through one, and a jet of air through the other, and united at a point a little beyond the orifices of the tuyeres and thus raise the temperature of the metal by the combination of the gases. Slag from a previous blow and mill scales may be used by introducing them by the opening, *h*, which is then closed by a stopper. The flame and heated gases will pass from *c* to *d* through the opening, *e*, and the slag and granules thrown over with them will collect on the floor of *d*, the flame and gases finally escaping through the opening, *j*, into the low chimneys, *k*. When the metal is sufficiently heated and refined, the workmen will raise the sliding door, *l*, remove the stopping, *m*, and allow the charge to flow into *d*, where he will ball it as in puddling and pass it on to the hammer or squeezer.

Mr. Bessemer adds that "the malleable condition of the metal when let down from the chamber, *c*, will render the stirring or puddling a much less laborious and more rapid process than the puddling of crude or refinery iron as at present carried on, *while the admixture of cinder with the granular mass will in the after-process of rolling, give to the iron that peculiar lamelar texture considered by some persons to be an essential peculiarity of bar iron.* Or, in lieu of raking or stirring, the chamber may be made to rotate or move to and fro, so that "the metal will be prevented from becoming solidified in a single mass, but will become broken up into fragments and mixed with the scoria, and thus resemble an ordinary puddle ball, but of much larger dimensions, or the mass so agitated may be turned out of the vessel into a mould or die in which it may be subjected to powerful pressure or repeated heavy blows," and rolled into bars, plates, &c., while still heated.

I have taken the liberty to mark by italics a portion of the above as it includes a remarkable theory, what Mr. Bessemer wisely, I think, merely puts forward as the view of "some persons." It is especially curious in this place, and followed by a device for breaking up the metal and preventing it from becoming solidified in a single mass, seeing that in other specifications homogeneity is claimed as a primary advantage, and which homogeneity, as we all now know, is truly and practically proved to be one of the great advantages of Bessemer metal, whether hard, soft or medium. A practical metallurgist who at the present day would regard the intermixture of cinder with the iron granules as an advantage would be a curiosity. All, I think, will now admit that the removal of such cinder is one of the primary objects of hammering, squeezing, reheating and rolling, and its presence in small residual and irremovable quantity one of the defects of puddled iron.

Such a clause introduced at this critical period, then samples of Bessemer steel were subjected to severe mechanical testing, and equally severe chemical analyses, and were, in many instances, breaking down under both (the important principle of selecting non-phosphoric pigs made from hematite not being yet understood), suggests the supposition that Mr. Bessemer had yielded to "some persons" who talked the customary talk of the period about "fibrous iron," and varieties of "fibre," and believed the belief of the period that such fibre is essential to toughness, and that it is due to the intercalation of cinder with true metal.

I am sorely tempted to state my own conclusions, based on an experimental investigation of this subject, but to avoid too much interruption of the historical narrative and unnecessary extension, will rather deal with it in a separate paper in the columns of IRON. A rotatory furnace, one of the devices by which the breaking up of the metal and intermingling it with the cinder to render it non-homogeneous was to have been effected must be described in my next paper. Though the special object for which it is introduced is never likely to be revived, it is interesting as a form of rotatory puddling furnice, which appears to have been overlooked during the epoch of rotators, which but lately passed away to give place to that of basic linings.

FRENCH DISTILLING APPLIANCES.

(Concluded from page 237.)

WE now come to the discussion of the distillation of molasses as obtained from sugar factories. As a rule this is carried on in conjunction with the last-named establishments. But little plant is necessary, since all that is required, are a few vats, a rectangular distilling apparatus, and a pump for raising the fermenting liquors. A distilling-plant, specially adapted for working up, is illustrated in the engravings which we give on the two preceding pages, figs. 6, 7, and 8 of which show one of these distilleries in plan, elevation and section. A is a semi-tubular steam-boiler, this type being much liked on the Continent owing to its economical consumption of fuel. B is a small engine used for working the pumps, the exhaust steam of which is utilised for heating the distilling columns. Care pumps for the fermenting juice and for boiler-feeding purposes. D is a chain pump for raising the molasses. The preparation or mixing vat is shown at E, whilst the vats where the fermentation process proceeds, are represented at F. G is a rectangular distilling column of the Savalle type; these are made to consume, according to size, from 2000 to 75,000 kilos. (approximately from 2 to 74 tons) of molasses daily H is a spirit tank, and the receiver for feeding the apparatus is shown at I. The rectifying vessel, J, clarifies the guildive and concentrates it to 96°, when it is received by the vat, K.

The employment of continuous presses, which is now becoming general, requires a pump for drawing in the pulp, and forcing it on to the filtering apparatus. This process is attended with certain difficulties, inasmuch as this pulp is in a pasty state, containing at times hard pieces of beet-root, which injure the valves. A pump constructed with a view of remedying these defects is illustrated in figs. 9, 10 and 11. This pump receives the pulp from the hopper shown in fig. 9, and passing it into the pipe, A, fills up the hollow space between the two pistons, *b* and *c*, which, as it were, perform the work of ordinary steam distributing valves in respect to the pump plunger, *d*. The latter is worked in the usual manner from a crank and connecting rod, which action is similarly repeated on the pistons, *b*, *c*, though their respective crank is set at right angles to the former, so as to work most advantageously in respect to each other. When the piston *d* is at the end of its stroke, the other two are just at half-stroke, so closing the pump-inlets; this position is shown in fig. 11. As soon as the piston *d* commences its return stroke, the piston *b* opens its passage or port, the piston *c* forcing some of the pulp behind the piston *d*, whilst the latter forces forward a certain quantity of the pulp out of the pump into the outlet pipe, *e*. As soon as the piston *d* has again finished the forward stroke, the pistons *b* and *c* are again against their ports, travelling always in the contrary direction to the travel of the piston *d*. The outlet pipe, *e*, is fitted with a safety valve, *f*, which in case of excessive pressure, returns some of the pulp into the two-piston cylinder.

Messrs. Savalle's press, differs from the Pecqueur system which is, largely introduced on the Continent, inasmuch as the beetroot pulp is placed under a progressive and continuous pressure. After about five minutes' pressure, the juice of the beetroot is fully extracted, whereas, in the Pecqueur press, the pressure is exercised in a tangential direction to the rollers, and being only momentary, the resulting pressure is not so efficient as in Savalle's press. The pulp proceeding from the latter is obtained in a dryer condition than if it had left an hydraulic press; nevertheless it is found advantageous to subject this pulp to a second pressing after re-moistening it. Messrs. Savalle's press, is constructed in various sizes. The size which appears to be most profitable from a practical point of view, is capable of pressing 40,000 kilos., (nearly 40 tons) of beetroot during twenty hours work. In using continuous presses, it is necessary to keep the beetroot slices in perfect order, by taking out and replacing the knives frequently, so that the beetroot may always be cut or pared regularly without producing any tough fibrous strings, which are apt to pass through the filtering surfaces of the press, Savalle's press adapts itself to numerous other purposes, such as for grape pressing, and for drying the residue obtained in the manufacture of potato starch and the like.

The rectification of alcohol, according to Savalle's system, separates it from all those ingredients adhering to it, either in solution, or through chemical affinity. This rectifier is represented in side elevations in fig. 12; A is a copper or iron boiler for receiving the alcohol about to be rectified. The latter is introduced with the addition of water of 40 to 50 centesimal degrees in order to facilitate the separation of the injurious oils. The interior of this boiler contains a heating coil, the novel arrangement of which facilitates the exit of the condensed vapours, and imparts greater strength to this part of the apparatus. B is the distilling column, and, C, is the tubular analysing condenser, which gives over to the column, A, two-thirds of the alcoholic vapours liquified, which were supplied to it for analysing purposes, whilst the remaining third of these vapours (richer in alcohol) are given over to the cooling apparatus, D, where this rectified alcohol is condensed and cooled. E is an automatic regulator, for regulating the heating of the apparatus and the generating of the alcoholic vapours, with an accuracy equal to the thousandth part of an atmosphere. A testing glass for indicating the volume of the stuff produced per hour is shown at F. For the purpose of separating and removing at the end of the process the heavy etherial oils, a steel dome, G, is provided. The cooler, D, and the condenser, C, are fed from the cold-water tank, H. A reservoir for the raw alcohol, where the secondary qualities are also run back, is shown at I. *g* is a bent pipe for the passage of the alcoholic vapours, whilst the weak alcohol is returned through the pipe *h*. The passage of the strong alcohol into the cooler takes place at *i*. A feed-pipe for the cold condensing water is shown at *k*, and the steam conduit pipe, *l*, serves for heating the apparatus. The warm water is discharged at *m*, whilst the boiler of the rectifying vessel is filled with raw alcohol through the pipe, *n*. *o* is the overflow pipe of the water reservoir, which prevents it from overflowing, and ensures the feed water to be delivered under a constant pressure. 1, is a special valve for the steam regulator; 2, tap for condensed steam; 3, two-way cock for filling and emptying boiler; 4, regulating valve for the admission of the condensing water; 5, outlet for the alcohol (secondary quality); 6, outlet for the ether; 7, outlet for the alcohol (fine quality); 8, safety-valve for preventing any injury arising through the formation of a vacuum inside; 9, man-hole, for facilitating access to the interior serpentine coil; 10, glass gauge for reading off the level of the liquid volume in the boiler; 11, thermometer, constructed specially for Savalle's apparatus, and indicating the different periods of manipulation, as well as the time when these should cease: and 12, is the outlet for the etherial oils.

THE IRON AND STEEL INSTITUTE.

OUR readers are already aware that the members of the Iron and Steel Institute have accepted the invitation of the German iron trade to hold their autumn meeting this year at Düsseldorf. It has been arranged that it shall take place on the 25th and four following days of August next, and a very interesting programme has already been proposed by the local committee, and approved of by the Council of the Institute. The first day will be devoted to the reception and to the mutual interchange of courtesies, the business of the meeting commencing on the 26th—Thursday. On the morning of that day there will be a general meeting of the members in the Town Hall, for the reading and discussion of papers. This will be followed by a luncheon in the Town Hall, to be provided by the German iron trade. It is proposed in the afternoon to visit the Exhibition of Art, Science and Industry, which will then be open in Düsseldorf, and to make excursions to works in the immediate neighbourhood of that town. The annual dinner of the Institute will take place in the evening. On Friday morning the members will meet to read and discuss papers, and after a luncheon in the Town Hall, provided by the local trade, they will proceed by the Cologne-Minden Railway for the Works of Oberhausen, Ruhrort, &c., which will be open for inspection. In the evening there will be a re-union and concert in the Town Hall. On Saturday morning the members will re-assemble in the Town Hall for work, and in the afternoon will proceed by the Bergish-Maerkisch Railway for the works at Bochum, Dortmund, Horde, &c., which will be available for inspection. The day's proceedings will conclude with a concert in the Town Hall. Sunday will be devoted to an excursion on the Rhine. Special trains will be provided by the German iron trade, from the Bergish-Maerkisch Railway to Coblentz, where luncheon will be provided by the German iron trade. From Coblentz the members will proceed to Bingen, where they will embark on special saloon steamers, provided by the German iron trade, for the excursion down the Rhine to Cologne, which will be reached in the evening. The Westphalian Coal Export Association have offered to throw open to the inspection of the members of the Institute the whole of their works and collieries, so that the visit promises well both for instruction and pleasure, and the meeting may be expected to be one of unusual interest.

STEAM TRAVELLING CRANE.

A NEW ironfoundry has recently been added to the already extensive works of Messrs. J. and G. Joicey and Co., the well-known engineers, of Forth Banks, Newcastle-on-Tyne. The building is 160 feet in length and 50 feet in width, and is lighted from the roof. It is specially adapted to the production of castings of the heaviest class, principally for marine engines. There are two cupolas, each capable of melting down four tons of iron per hour, and as much as twenty-six tons has recently been cast in the foundry in one afternoon. The principal mechanical feature in the building is an overhead steam travelling crane, by Messrs. Joseph Booth and Brothers, of Rodley, near Leeds. It is carried on 48-feet girders, and runs upon ways placed at each side of the foundry, and whilst either lifting or lowering it moves along and across the shop at the same time with ease and precision. It is designed to lift twenty tons, but Messrs. Joicey and Co. have had twenty-one tons lifted and removed by its aid. The girders are made of wrought iron, box form, with steel rails riveted on the top; the end carriages are of cast iron, and are firmly bolted to the girders with turned bolts. They have steel-tired tram wheels and steel axles, running on gun-metal bearings. The gearing is double purchase, with disengaging pinions, and a powerful brake, worked by means of right and left hand square-threaded screw and hand wheel. The chain barrel is grooved with right and left hand thread. There is also a cross-bar, with pulley, for supporting the chain, the two extreme ends of which are fixed to the end of the barrel, and as the weight is lifted the two chains meet together in the centre of the barrel, thereby hoisting and lowering vertically, which is very essential for foundry purposes in lowering large cores into the moulds. The crane is worked by two inclined engines, which are fixed to the crane sides, and are fitted with reversible link motions. All the journals are bushed with gun-metal. The boiler is one of Messrs. Booth Brothers' latest patent, with two cross tubes in the firebox. After the flame leaves the firebox it enters an outer chamber (which is lined with firebrick), and makes three ascending revolutions round the shell before entering the chimney, thereby economising fuel, the average consumption of coal and coke, it is said, being 2 cwt. for ten hours' work. The chain barrel is fixed lengthways between the girders, thereby distributing the weight equally upon each beam. The longitudinal and cross-traversing motions are all worked from the main shaft with friction wheels, and are put in motion by screw-levers. An important feature of the crane is that the whole of the motions are under the entire control of one man, and can be worked separately or combined.

OCCASIONAL NOTES.

A HEAVY THEFT.

THERE is a story of a Scotch borderer, while on his way back with a drove of cattle which he had "lifted" from some English homestead, accosting a fine haystack with, "If you had four legs you should go too." There are some people, however, for whom nothing in the way of booty is either too hot or too heavy, and amongst these must undoubtedly be classed the engineer of a railway in the metropolis, who was reported to have filched a locomotive, and the gentlemen who, not very long ago, "conveyed" eight million pounds avoirdupois of iron from Juposan Ironworks, in the Russian mining district of Ufa. Russian employés beat the world at this game, and in the present instance it is believed that the whole staff of officials employed in these works has been concerned in the gigantic transaction, while it is added that small hope is entertained of bringing direct culpability home to any individual.

MANCHESTER WARES.

It is not only the heathen Chinee who objects to china clay in his textiles. The Bishop of Cottonopolis, who may be considered as, in one sense, a bishop *in partibus*, has been lecturing his flock on the intimate connection between dishonesty and infidelity, and showing them what by this time they ought to have found out for themselves, that commercial prosperity or depression depends more upon moral than material causes. Bishop Fraser is an honest, outspoken prelate, and homely withal, and on the occasion referred to he employed a homespun illustration for the enforcement of his argument. Like one of his apostolic predecessors, he carries a bag, which in his case is used to contain his robes of ceremony. For many years he had, he said, used one given to him by the widow of the Bishop of Salisbury, but it having become shabby with long service two years ago, he treated himself to a new one. That bag, he declared, was now nearly as shabby as the old one had become after seventeen years' wear, notwithstanding that he had given a good price for it, telling the tradesman, indeed, that it must be of the best material he could produce.

THE "ATALANTA."

The weight of professional opinion that has been advanced against the seaworthiness of this ship renders it all the more necessary that the promised inquiry into the circumstances attending her loss should be made by a tribunal, not only perfectly impartial, but above the suspicion of bias or prejudice. One composed of the officials who sent her out, or of their colleagues, is obviously out of the question. In a recent letter to *The Times*, Mr. E. J. Reed strongly insists upon this view. He points out that the reverse has usually been the practice. In the case of the *Captain*, the inquiry was made by an ordinary court-martial, neither was there an independent inquiry in that of the *Eurydice*, and Mr. Reed observes that the habit has been acquired of allowing the Admiralty to adjudicate on its own shortcomings. That department, as he indicates, will substantially be on its trial in any investigation that may be held, and a course such as he objects to would have the further disadvantage of preventing light being thrown on any causes, connected with the administration of the department, that may have had a share in occasioning the catastrophe. In support of this view, Mr. Reed mentions that a rumour is afloat to the effect that the *Atalanta* was selected and equipped for her service without the usual approval of the Controller of the Navy.

SHIPS' BOATS.

It is a wonder that the circumstances connected with several recent disasters at sea have not led to a revision of the means provided for the safety of passengers in the event of shipwreck. When even the largest vessels were of comparatively small tonnage, a couple of ordinary stoutly built ships' boats amply sufficed for communication with the shore, and in the event of the ship being disabled furnished a competent means of escape for the crew. But the great increase in the size of ships, and the immense enlargement of the passenger traffic, has altered all this. Nowadays in passenger ships there is rarely if ever sufficient accommodation in the boats for the persons on board, even if these can be safely lowered and prove seaworthy when in the water; while even then the fate of the passengers rescued from immediate death is often worse than that of those who have gone down in the ship. A suggestion on this point has been made, regarding which the most remarkable thing is that it has not been made sooner. It is that mail and passenger steam-ships should be compelled to carry a large and serviceable steam-launch as part of their equipment, which would be most useful, in case of shipwreck, for towing the ships' boats to land; or, when a vessel has been disabled, but still remains seaworthy, it could be sent to the nearest point for assistance. There have been instances of late years in which large vessels have been wrecked and all on board landed on an arid shore without any means of progress overland, only to suffer the most intense privations, when a steam launch would have brought them help in a few days.

WOOD PAVING.

A large contract for wood paving in the parish of St. George, Hanover Square, has recently been completed, the work having been got through in a very short time. This rapidity of execution is an incidental advantage of wood as compared with most other paving materials. Asphalte, which is somewhat cleaner, and makes a still quieter street, is more incommodious, owing to its slipperiness, especially when it acquires a coating, however thin, of London mud; and to lay it down is as slow a process as the construction of a roadway with granite blocks; while with wood there is also less of the dust which annoys passengers and damages the shopkeeper's wares, than in the case of either granite or macadam. Wood pavement, however, has drawbacks of its own; and these have lately found a zealous exponent in the American General Sherman, who stands up for stone, and contrasts the Appian way and the streets of Pompeii with the Washington thoroughfares. Wood, he insists, is not as durable as granite, and loose cobble stones, agglutinated by a little coal tar, and covered over with a smooth film of imported cement, do not, he considers, fulfil the conditions of a good roadway. Admitting that the asphalte roadway is pretty to look at, and pleasant to those who ride in carriages, he adds that "the poor horses groan at the hard, slippery surface, and actually laugh when they reach the suburbs, and find natural soil and gravel under their feet." The general farther declares that the miles of wooden pavement of the Republican capital are now rotten, impassable, and worse than the old corduroy roads of Illinois. In conclusion, he maintains that granite, porphyry and blue stone, the productions of the Creator, are better for road-making than the inventions of man, and that although "nothing can stand for ever the eternal action of the shod hoofs of horses and wheels," the rocks in question are the best for road-making, the most enduring and economical. There is some force in the objections urged against wood paving on the score of durability and sanitary requirements, but they are not insurmountable. In a city like London, greater quietness alone is worth a considerable sacrifice. Silence in such a case is really golden.

THE CARE AND CARRIAGE OF EXPLOSIVES.

We have on several occasions called attention to the dangerous practice of smuggling dynamite and other explosives for the purpose of evading the stringent regulations which the railway and shipping authorities have been compelled to adopt in the interest of the public safety. It has been shown that quantities of these dangerous substances, sufficient to blow the train into fragments, have been quietly carried in carpet bags in railway carriages, and such packages have been found to figure not unfrequently as the luggage of omnibus passengers. This perilous traffic appears to be carried on as actively as ever, as appears from a report by the Inspector of Explosives, just published, in which it is stated that consignments of gunpowder have been transmitted from this country to Egypt by passenger ships in metal cylinders represented to contain oil, the cylinders being so constructed, with an inner longitudinal partition, that a portion amounting to about 1-10th of each cylinder, was able to and actually did contain oil, and when the tap with which this portion was provided was unscrewed the oil could be poured out, without any suspicion being excited that the remaining 9-10ths of the cylinder contained not oil but gunpowder. What danger may arise from careless handling of explosives, especially of dynamite and its allies, there are already abundance of incidents to show. Several recent accidents of this description on the Continent are positively appalling. At Faido, a short time ago, through careless handling, a quantity of dynamite belonging to the contractor for the St. Gothard Tunnel, and stored in a cellar under a village school, exploded, killing two children and their teacher, and injuring sixteen or seventeen others. The explosion in this case was only partial; for there is said to have been sufficient dynamite in the cellar to blow the whole village into space. About three years ago a clandestine manufactory of this explosive in North Italy, close to the French frontier, was blown up, and it was then discovered from the proprietor's papers that he had sent ten casks, each containing 1000 kilogrammes, to the Genoa Railway Station as artificial manure. They were traced and confiscated. The French Government sent experts down from Paris to look into the matter and decide how the dynamite should be dealt with. Instead of destroying it, they ordered it to be taken to Lormont, a small fort in the Jura, and placed in the magazine there. A short time afterwards the Fort of Lormont was blown into the air, and not one of the twelve men who constituted its garrison has ever been seen since.

AGRICULTURAL STATISTICS.

The reaction of the seven or rather ten years of famine upon our domestic manufactures must have brought home to the least sagacious the close interdependence existing between the agricultural and commercial interests of the country. Our whole foreign trade does not amount to much more than a seventh part of British commerce, and a deficient harvest, or a murrain on the herds and flocks, disarranges our entire industrial economy. Great interest consequently attaches to two important papers read at the last monthly meeting of the Statistical Society, one by Captain Craigie, the indefatigable secretary of the Central Chamber of Agriculture, on the statistics of British agriculture during the last decade, and the other by Messrs. J. B. Lawes and J. H. Gilbert, good authorities both of them, on the home produce, import, consumption and price of wheat over the past twenty-seven years. Captain Craigie showed that the actual corn-bearing land in the country had during the last ten years been reduced by from two to four per cent., while the pasture had increased by over a million acres. It is noteworthy that the withdrawal of arable land from cultivation has taken place almost wholly in those districts where the climate and soil are less favourable to the production of grain, where indeed the cereals can only be grown profitably under much higher prices than have ruled of late, and that in the eastern counties there has been scarcely any diminution; while the extension of pasturage has been in the grazing districts, where the conditions are unfavourable to cereal husbandry, but well adapted to pasture. The importation of grain under free trade has thus resulted in a practical commentary on the evolutionary doctrine of the survival of the fittest. Yet, notwithstanding this large increase in the permanent grass area, there are now no larger flocks grazing it than there were ten years ago in the same region, partly, no doubt, owing to the ravages of disease, but also to the more frequent combination of cattle rearing with arable farming in the cereal districts. The authors of the second paper estimated the decrease of the area under our most important cereal in the last three as compared with the first eight years of the term covered by their researches at about 20 per cent., the annual value of imported wheat having risen in recent years to £20,000,000. Over the whole period, the authors estimate, 40·4 per cent. of the wheat consumed was derived from imports, and the amount supplied from foreign sources increased from an average of 26·5 per cent. of the total over the first eight years to 57·4 per cent. of the total consumed over the last three years, a state of things which accounts for much of the late and existing depression in the home trade.

THE DEPHOSPHORISATION OF IRON IN THE BASIC-LINED BESSEMER CONVERTER*.

By M. A. POURCEL.

(*Concluded from page* 348.)

I SHALL borrow my examples from Mr. Stead's Table of Analyses, given below. The operation on which the English chemist based his studies was made at the Eston Works, and in this instance the preliminary addition consisted of 20 per cent. of lime without Blue Billy. The analyses show that, after 14½ minutes' blowing, the carbon having been reduced to a minimum, the fluid slag, which had not been rendered pasty by lime, was still very silicious. The neutralisation of the silica by the lime had not been completely effected during the normal operation, and the formation of the basic slag, without which the complete oxidation of the phosphide of iron is impossible:—

ANALYSES OF METAL AND SLAG AT DIFFERENT PERIODS OF THE BESSEMER OPERATION.

(BASIC-LINED CONVERTER.)

Time elapsed from the commencement of the blow.	Analysis of the metal					Analysis of the slag.		
	Manganese.	Carbon.	Silicium.	Sulphur.	Phosphorus.	Silica.	Phosphoric acid.	Metallic iron.
Initial pig	0·710	3·570	1·700	0·060	1·570	—	—	—
After 3 minutes blowing	0·620	3·680	0·810	0·060	1·600	32·60	0·60	5·65
,, 6 ,, ,, ...	0·560	3·400	0·280	0·060	1·630	42·60	0·15	2
,, 9 ,, ,, ...	0·380	2·350	0·050	0·050	1·430	36	1·60	4·60
,, 12 ,, ,, ...	0·270	0·880	0·010	0·050	1·420	35·60	2·61	4·80
,, 14 min. 30 sec. ,, ...	0·120	0·070	traces	0·050	1·220	33	5·66	6·15
,, 16 ,, 30 ,, ,, ...	0·100	traces	0	0·050	0·140	15·60	15·06	10·45
,, 16 ,, 35 ,, ,, ...	traces	traces	0	0·050	0·080	16·60	16·03	11·35
Sample taken in the casting ladle ..	0·270	0·124	0·030	0·040	0·220	18·60	13·87	7·10

only takes place during the overblow. During this period two simultaneous reactions take place counteracting each other, and this circumstance naturally results in the duration of the overblow being prolonged in order to effect a sufficient elimination of the phosphorus.

This is the principal drawback in a large proportion of silicon, and it can only be met by increasing the preliminary addition of lime beyond all practical limits, so as to augment the surfaces of contact, or by injecting this reagent through the tuyeres, which does not recommend itself from a practical point of view. If, at the commencement of the period of overblow, the silica of the slag is not completely neutralised by the lime, it partly decomposes the phosphate of iron which now begins to form, robs it of its oxide of iron and sets free the phosphoric acid, which seeks in turn to combine with fresh portions of iron oxide. But simultaneously the oxide of iron is displaced from its combination with the silica by the lime and set at liberty. The bath being no longer reducing since merely traces of carbon remain, this oxide of iron cannot be reduced as it is during the normal period of the blow; and furthermore, not being in sufficiently intmate contact with the phosphoric acid, which has just been displaced so as to combine with it, it remains dissolved in the bath. Now the more silicon the pig contains, so much the more acid will the slag be before the overblow. Consequently the duration of this period will be increased more oxide of iron will be dissolved in the bath, and will necessitate an increase in the weight or richness of the final addition.

---

* Paper read before the Société de l'Industrie Minérale. March 6, 1880.

The violent disengagement of carbonic oxide is thus explained, and what results from it, reabsorption of phosphorus into the metal. Thus, in the example given by Mr. Stead, we see that before the final addition the metal contains 0·08 per cent. of phosphorus, after 0·22 per cent., whilst the slag loses 2·16 per cent. of phosphoric acid, and at the same time 4·25 per cent. of iron. At Hörde the addition of the spiegel is unaccompanied by any considerable ebullition in the metal, and I have attempted to account for it in the following manner. At the same time there is no reabsorption of phosphorus. The analysis of an average sample of slag taken from the three operations quoted by Mr. Messenez is:—

Silica	11·10	
Phosphoric acid	12·43	
Magnetic oxide of iron, Fe_3O_4	11·25	= Fe 7·65 per cent.
Manganous oxide	4·40	
Lime	50·21	
Magnesia	9·84	
Sulphide of calcium (CaS) ..	1·15	
	100·38	

Such a slag is not fusible; it must be formed of a silicate, or rather a silico-phosphate of definite proportions, well fused, in which solid lime is impasted. We can conceive that such a compound could not be penetrated by the carbonic oxide (which would not be present in large quantity), and would protect the phosphate of iron from the reducing action of this gas if it is in this state that the scorified phosphorus exists in the slag. It is, then, rather by physical means that the reabsorption of phosphorus is avoided than by any chemical action attributable to the lime.

Referring again to Mr. Stead's analyses, the results there indicated are:—

(1) That the phosphoric acid does not attain any notable proportion in the slag until the carbon in the metal is reduced to 0·07 per cent.

(2) That the phosphorus and the iron increase *pari passu* in the slag.

(3) That the addition of the speigel brings about an increase of phosphorus in the metal, corresponding to a diminution of phosphoric acid and iron in the slag.

Is not the establishment of this last fact an argument in favour of the existence of phosphate of iron in the slag; and may not carbonic oxide be the reducing agent of the phosphate of iron? Mr. Stead, without stating so positively, but believing that he has satisfactorily shown by analyses and syntheses of calcareous slags, that the phosphorus they contain is in combination with lime, is of opinion that it is carbide of manganese, or even manganese itself, which is the reducing agent.

My answer to this is: Firstly, that if in the place of spiegeleisen we add charcoal pig, free from silicon and manganese, or containing but traces of these bodies, and that the disengagement of carbonic oxide consequent on this addition is abundant and violent through the fluid slag, there is a reabsorption of phosphorus into the metal. Secondly, if, on the contrary, we add pig-iron with little or no manganese but containing a sufficient quantity of silicon, more silicon than carbon, all disengagement of carbonic oxide is suppressed, and no further reabsorption of phosphorus can be detected in spite of the fluidity of the slag.

I attributed the reabsorption of phosphorus to the abundant disengagement of carbonic oxide; well, the presumed cause being suppressed, the effect disappears. What conclusion is to be drawn from this?

(For the reactions of silicon and silicide of manganese, I beg to refer the reader to the theory of the manufacture of solid steel castings which I had the honour to present for the first time with some supplementary details at the meeting of the *Société de l'Industrie Minerale*, November 8th, 1876.)

Professor Ehrenwerth of Leoben, in an exhaustive dissertation, supports my opinion that the phosphorus passes into the slag as a phosphate of iron, and adopts my formula $2\ FeO, PhO_5$. But arguing on two analyses of slags sent him from Horde, and which are, with the exception of a higher percentage of lime, very similar to the one I quoted above—that is to say, that the oxide of iron they contain figures as magnetic oxide—Mr. Ehrenwerth concludes "that in contact with lime, the phosphate of iron would be decomposed, a phosphate of lime would be formed, and the protoxide of iron set at liberty, but impasted in the slag, is transformed into magnetic oxide under the oxidising influence of the air."

The presence of magnetic oxide is a possibility but scarcely a certainty. I freely admit that in the face of the results obtained at Horde this point is of little importance practically.

The chief thing is, that the percentage of phosphorus in the metal before and after the addition of the spiegel should remain the same, and this result is obtained.

But as regards the part attributed to the phosphorus as a heating agent, this theory is important and open to discussion. Already the heat of combustion of phosphorus has been compared with that of silicon, and figures have been adduced in support of this view. In my opinion this is an illusion, and the few remarks I am going to submit to you will explain why I consider that too much haste has been shown in establishing laws. In calculating the heat developed by different calorific elements which enter into the pig-iron, the calculation is applied by admitting that these different bodies exist isolated outside of any combination.

Silicon develops 7830 calories, manganese 8000, phosphorus 7500. Consequently, it is concluded that phosphorus may replace silicon equivalent for equivalent as a calorific element. But neither silicon nor phosphorus exist isolated in pig-iron. In a pig free from manganese, silicon exists as a silicide of iron; in a manganiferous pig as a silicide of manganese, a compound more stable than the preceding, and whose formation is accompanied by a very great evolution of heat. It is thus that the conditions shown to exist by analysis in isolating silicide of manganese from the pig which contains it, are found to be in conformity with the laws of thermo-chemistry.

Referring to the calorimetric studies carried out on the silicides of manganese and iron by Messrs. Troost and Hautefeuille (Annales de Physique et Chemie, 5th Series, Vol. ix., page 56.) The solvent used was bichlorate of mercury. These gentlemen established by experiment—

(1) That the heat of oxidation of a silicide containing 8 per cent. of silicon, 1 per cent. of carbon and 91 per cent. of manganese was 1330 calories; whilst the heat calculated from the elements composing the body was 2160 calories, 1910 for the manganese, with 10 per cent. of carbon, and 5140 for the silicon.

(2) That the silicide composed of 12 per cent. silicon, 1 per cent. carbon and 87 per cent. of manganese develops only 1250 calories, *i.e.*, less than the preceding one, whilst the heat calculated from the elements is 2280 calories. The silicides of manganese whose formation is accompanied by an enormous evolution of heat, form in preference to the silicides of iron, which develop less, as will be presently shown. First point to be noted. Second—the heat of oxidation of the silicides of manganese decreases in proportion as the silicon increases.

The silicides of iron form without any great evolution of heat. For instance, a silicide containing 3·5 per cent. of silicon and 0·6 per cent. of carbon develops 970 calories by its oxidation, *i.e.*, exactly the quantity that would be developed by the sum of the elements taken separately; and a silicide of iron with 14 per cent. of silicon and 0·4 per cent. of carbon develops by its oxidation 1270 calories, or something less than the amount arrived at by calculating each element separately, which would be 1425 calories—pure iron developing 827 calories.

To resume, the calorific power of a pig free from manganese increases with the silicon, whilst with two pig-irons containing the same proportion of manganese, the calorific power seems to be in inverse proportion to the content of silicon.

As regards phosphide of iron, experiment has proved that its formation also is attended by a great evolution of heat, and that consequently it must be considered a very stable compound. In fact, on treating two samples of pig containing respectively 5 per cent. and 9·5 per cent. of phosphorus, Messrs. Troost and Hautefeuille obtained 790 calories for the former, and 480 for the latter.

Each of these calorimetric experiments was made with one gramme of material. Similarly the heat developed by the oxidation of the compound (Fe_2 Ph), containing more than 36 per cent. of phosphorus should be inferior to 480 calories. These calorimetric studies give us an idea of the relative heat of combustion of these different compounds at the temperature of the converter, at which their stability is not impaired; and even if they afford no precise information, they point out, at least, that in calculating the quantities of heat developed in intermolecular combustion in the Bessemer process, a serious error is perhaps committed by taking as data the heat of combustion of the different elements considered separately. It is evident that in the basic converter the manganese becomes more powerful as a calorific element than in the silicious converter, where its dissolving action on the silica of the lining would occasion a considerable loss of heat. The strong basic affinity of its oxide fixes the silica of the silicon from the very commencement of the blow (as shown by the analysis below), and produces a stable silicate, very fluid, which dissolves the solid lime more rapidly, is more quickly neutralised, and facilitates the incorporation of the phosphate of iron.

Analysis of a Bessemer slag, silica lining, taken after the scorification of the silicon:—Silica, 69·50; manganous oxide, 22·20 = manganese 17·08; protoxide iron, 4 = iron 3·12; other bodies not estimated.

In fact, if the oxidation of the phosphide of iron develops heat, the decomposition of the phosphate absorbes heat. In accordance with the laws of thermochemistry, the quantity of heat absorbed, should be equal to the sum of the heat developed by each of the composing elements at the moment of their combination; that is to say, the heat developed by the iron and the phosphorus in combining, and by the phosphide of iron in oxidising. On the other hand, phosphoric acid in combining with lime develops heat, it is true. But there is first of all a change of state and subsequently a dissolving, two reactions which absorb heat. One of the composing bodies, the lime, is solid, and we cannot imagine the formation of the phosphate of lime without supposing that this salt is formed, and dissolved simultaneously in the fluid silicate already existing.

In this manner, the phosphorus might become negative as a calorific element, or at all events of so little value as to be neglected. However, Mr. Massenez assures us, and I quite believe it, that experience proves the contrary, which shows that all these reactions are more than hypothetical.

To resume, gentlemen, my conclusions are negative, and with this I may be reproached. I undo those that have been made, without replacing them with surer ones. However, I do not think my work entirely useless in confining it to that of the critic, who, if he does not himself discover the truth, points out in what direction it should be sought. A distinguished man, Mr. Paul Trasenster, professor at the school of Mines of Liége, has done me the honour to associate my name with that of Mr. Lowthian Bell, and he addresses to both of us a reproach which I am sure Mr. Bell does not deserve. After quoting the analysis of Mr. Bell's experiments in dephosphorisation, as also those made by myself some five or six years ago on "the phosphorisation of pig-iron in a basic-lined crucible by means of phosphate of soda," Mr. Trasenster says that, all said and done, our conclusions gave very little encouragement to those who were endeavouring to carry out dephosphorisation in the converter. I answer that, as far as I am concerned, in publishing my laboratory experiments with all their accompanying details, I gave every one the opportunity of repeating them and checking my results. I have stated, "that with sufficient heat, no matter what the degree of basicity of the slag, the phosphates are decomposed in contact with pig-iron or carbide of iron, which absorbs the phosphorus." This is perfectly true, and had been previously announced by Caron, though unknown to me at the time, as being true for the phosphate of lime.

If my conclusions have been generalised, perhaps because I failed to define their limit with sufficient clearness, a construction has been put upon them which I never for one moment intended.

My motive, in pointing out the object of my work, is to protect myself now from such an interpretation. As criticising the process from a theoretical standpoint, my conclusions from a practical point of view are that, the pig which will best answer to a practical solution of the Thomas-Gilchrist process, will contain, as Mr. Massenez states, 1 per cent. at most of silicon, better 0·5 per cent.; 1·5 per cent to 2 per cent of phosphorus, according to the composition of the raw material; without going to the exaggeration of adding phosphide of iron to increase its heating power in the converter, which should, on the contrary, be assured by a due amount of manganese in proportion to the content of silicon, and in accordance with the equivalents $SiMn_2$; or better, $SiMn_3$.

The communication of Mr. Massenez was translated *in extenso* in the newspaper, *La Métallurgie* of the 28th of January, 4th and 11th of February, 1880.

SCIENCE AND ART.

PROCEEDINGS OF SOCIETIES.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the meeting on Tuesday, the 27th of April, Mr. Barlow, F.R.S., President, in the chair, the paper read was on "The Amsterdam Ship Canal," by Mr. H. Hayter, member of Council.

The object of this undertaking was to provide a direct and improved deep-water communication between Amsterdam and the North Sea. The principal works consisted of a dam across lake Y, to exclude the waters of the Zuider Zee from the canal, and which was pierced by the Zuider Zee locks and sluices; of the North Sea locks, for shutting out the waters of the North Sea from the canal; of the Land Reclamations, intersected by branch canals, to maintain existing navigations and drainages, and dividing the reclamation into polders; of the pumping machinery; and of the North Sea harbour and breakwaters. In general terms the canal might be said to include one long reach between the Zuider Zee and the North Sea locks, and a short tidal reach between those locks and the North Sea harbour. The long reach was required to be maintained by sluices and pumping, at a level of ½ metre below Amsterdam Standard Level (A.P.)—or about 14 inches above ordinary low water in the North Sea—for the purposes of drainage and for the protection of the district. The Amsterdam ship canal had a bottom width of 88 feet 7 inches, whereas that of the Suez Canal was 72 feet, and of the North Holland Canal only 30 feet 10 inches. To excavate the Canal ordinary dredging machines were at first employed, the material being deposited in barges and removed by barrows on to the banks. Subsequently the material falling from the buckets of the dredger was received into a vertical cylinder, fitted to the dredger in which a Woodford Pump revolved, and being mixed with water to reduce it to a semi-fluid state it was forced by the pump through a line of wooden tubes connected by leathern joints. These tubes were fitted with buoying pieces to enable them to float on the water, and passing on to the banks deposited the stream of mud. The longest length of tubes was 300 yards, and the greatest height of discharge had been 8 feet. Twelve dredging machines were employed in the excavation of the earthworks, to six of which the delivering apparatus was fixed. Two large dredgers, under ordinary circumstances, were each capable of lifting and depositing on the banks, through the tubes, about 1700 tons, or 1300 cubic yards of material per day of twelve hours, at a cost of about 1½d. per ton. The quantity of material excavated, including the dredging in the North Sea to form the harbour, had been about 21,000,000 cubic yards. To keep the waters of the Zuider Zee from flooding the lands drained by the canal, and to maintain the water in the canal at ½ metre below Amsterdam standard level, a dam was constructed across lake Y, about two miles eastward of Amsterdam, its total length being 4462 feet. In this dam were the Zuider Zee locks, at a distance of 984 feet from the northern shore of the lake. The execution of the dam across a tidal channel nearly a mile wide—involving the construction of an extensive system of locks, sluices and pumping machinery—was one of the most remarkable features of the enterprise. To lessen the sinkage, mattresses of fascines, about 2 feet 6 inches thick, were laid over the whole breadth of the dam, and were so woven together as almost to resemble basket-work. Exterior dams of fascine work were then built to low-water level, the space between them being filled with clay and sand. The Zuider Zee locks, three in number, including one passage or large sluiceway, and three small sluiceways, were built within a circular cofferdam. This dam was 525 feet inside diameter, and consisted of two concentric rows of sheet piles, with a clear space between them of 6 feet 6 inches. The outer row of piles was of whole timbers, and projected 8 feet above high water; but the inner row was only 8 inches wide, and was not carried up above high water. In constructing this dam a dolphin was first erected in the centre of the area to be enclosed. At the commencement, some difficulty was experienced in getting the piles of the exterior ring set out correctly. First a hempen rope, previously strained, was fastened to the central dolphin; but the rope stretching irregularly, the piles were not true to a circle. Afterwards, floating rods were resorted to, but the wind and tide deflected them sideways. At last a light iron-wire rope, kept strained by a weight, was used. For a few days this gave irregular results, but soon acquired its maximum stretch, and became sufficiently accurate. As it was found that if the guide piles were set out 10 feet apart, the resulting curve was not regular, they were spaced spaced 40 feet apart.

Three pile engines were then set to the curve, on a radial lighter 40 feet broad at one end and 20 feet at the other, and these drove three piles equidistant in the 40 feet square. Numerous difficulties were experienced in preserving the contour of the dam, in resisting and meeting a violent south-west wind, in overcoming a stream of water in the pump well, in dealing with floating ice in winter, and in connection with the leakage occasioned by through bolts. Eventually all these troubles were surmounted, the several expedients resorted to being described, and the locks and sluices were finished. The largest of the Zuider Zee locks had a length of 315 feet and a width of 60 feet. The other locks—one on each side of the large lock—had each a length of 238 feet and a width of 47 feet. The three locks had each five pairs of gates, two pairs, pointing in opposite directions, being placed at the ends of the locks, and one pair in the middle pointing towards the Zuider Zee. The North Sea locks were two in number, and there was one passage or sluiceway. One of the locks was 390 feet long and 60 feet wide, the other was 227 feet long and 40 feet wide. An important feature of the undertaking was the reclamation of lands from lakes Y and Wijker Meer. The area reclaimed had been upwards of 13,000 acres, and this had effected a considerable change in the physical features of the country. The main reliance for keeping the water under was on the pumping machinery at the Zuider Zee locks. The power to be provided was fixed at 12 horse-power for every 2500 acres, and for each metre in vertical height to which the water had to be raised, and for reducing the level or the water to 1 metre under the lowest level, or surface of the land in each section. The pumps were centrifugal, varying in power from 24,000 cubic feet of water lifted 7 feet 2 inches per minute at the Zuider Zee locks, to 812 cubic feet of water lifted 8 feet 10 inches per minute at Polder VIII. The reclaimed land was divided into twelve polders. The superficial area, the mean lift of water in each case, the quantity to be pumped, and the principal dimensions of the pumping machinery, engines and boilers, were given in detail. The largest adjuncts to the canal were the harbour and breakwaters in the North Sea, forming and protecting the approach from the ocean. The harbour was enclosed by north and south breakwaters, each nearly a mile long. They sheltered an area of 250 acres, through the centre of which a channel 738 feet wide had been dredged. At the landward end this channel had, at its junction with the canal, a guide-pier on each side, 361 yards long. The breakwaters were formed of concrete blocks, resting on a mound of stone, the blocks being set in place, for the most part, by overhanging travelling cranes. In consequence of the tidal range being greater than was at first assumed, it had been found necessary to add wave-breakers on the sea sides of the breakwaters. The interior moles were constructed of fascines and stones. Nearly 5½ million cubic yards of material had been taken out of the dredged channel and deposited at a minimum distance of 3300 yards from the coast line. The machines used for removing this material were principally sand pumps. When at work the suction pipe of the pump tended to bury itself in the sand, being held by a lifting chain at the most effective point, which was found to be from 3 to 4 feet below the surface of the ground. Each machine raised on an average about 1300 tons per day. The costs of raising the material and of depositing it in the barges are somewhat under one penny per ton when the sand pumps were working. It is impossible to state with precision the actual cost of the work; but, altogether, the expenditure had amounted to somewhat under three millions sterling, without taking credit for the sale of the reclaimed land, which realised on an average about £70 per acre.

MANCHESTER GEOLOGICAL SOCIETY.

AT a recent meeting of the members of the above society Professor Boyd Dawkins occupying the chair,

Mr. J. Aitken called attention to recent finding of several large boulders in the neighbourhood of Manchester, and also to the discovery of a number of erect fossil trees near the Lower Moor collieries. The Chairman observed, with regard to the discovery of the trees, that he did not think a finer illustration of this particular description had ever been brought to light in the country.

THE LONG-WALL SYSTEM OF WORKING COAL.

Mr. W. J. Grimshaw read the third and concluding part of a paper prepared by himself and Mr. Herbert Phillip on "The Long-Wall System of Working Coal." He said in comparing different modes of coal-getting it was requisite to consider the comparative getting facilities of different coals, as this had an important bearing upon the "charters," and the get per head. It might be remarked *en passant* that collating the number of tons wrought per life lost, was, as a test of efficient working, to a certain extent misleading. If in one district two tons of coal were wrought as easily as one ton in another, it should follow, other considerations apart, that the greater "get" per life lost should be in the former district. The reverse, however, might be the case when the hardly-wrought seam was gotten by a superior system to the more easily-worked one; but cases in which such a great difference obtained would be very few and far between. A record of the time spent under ground during the year by the total number of underground employés might possibly be a useful record for comparison, and certainly would be an interesting one. An account of the relative progress of the different systems of working coal during, say, the last ten years, would afford some valuable information; but such a review would require very careful and cautious handling. The circumstances under which a miner could get the greatest quantity of coal were when his thorough and continued attention and efforts could be applied to the department for which he was best suited. The skilled miner should, to obtain the best results, devote the whole of his time to skilled work. Any deviation to work which could be done by a less-skilled workman was a loss of economy, yet this was an often-broken rule. The hewer wasted his time in loading, the loader wasted his time in tramming, and the management lost by both. The advantages of a proper division of labour were not thoroughly and generally understood. People constantly engaged in some manual occupation often attained a skill which seemed marvellous to an observer, and constant practice seemed to endow them with a kind of intuition, or almost instinct, which seemed wellnigh infallible. It was claimed for the long-wall system that the principle of adjusting the right man to the right place, and keeping him there, could be adopted more readily than in any other system. Holers or undercutters were generally active young men who were very expert with the pick. The packing or timbering was done by the stall-men or contractors. Loaders were generally more remarkable for strength than skill, in fact the form in which many of the cowls were got required considerable strength in the loaders to put the blocks entire into the trains, thus getting rounder coal and saving the waste which would be entailed by breakage. Tramming was principally performed by boys under the direction of a few men. All these separate operations, the first three of which were in some systems performed by the same man or men, were relegated to men who performed the same work for years. The last operation, tramming, had a very important influence on the others. They were taking for granted that the haulage arrangements would permit of a necessary supply of trams at the different points where required for distribution. Nothing would tend more to elevate charters than an irregular supply of trams. If the demand on the stallmen's fluctuated the maximum capability could not be arrived at. At one time getters and loaders were wasting time in waiting for trams, and at another coals could not be obtained from the working places. Such arrangements as would ensure an efficient and regular supply of trams to each stall would be most economical. If this rule were followed, in a short time the maximum producing power of each stall would be ascertained, and in this position the "charter" for getting reached its maximum and would then be ruled by market influences only. Several tables showing the prices paid for hauling and the comparative getting facility of different coal-seams were then read, and these showed that the tonnage prices and the average get per man produced nearly the same wages in the different mines, although the quantity a man was able to get varied considerably, but the reader observed that it would be utterly impossible to give a scale of cost that would even approximately apply to the generality of mines in working. It might be safely said that a man working in a face of coal was capable of producing, say, as a rule, twice as much coal as a man working in a straight place, and in addition to this his coal would be in a more saleable condition. The item of yardage in pillar-and-stall work was very considerable, and against this had to be set the cost of gateroads in the long-wall system. Many "sorts" of coal were made at most of the Midland collieries, and it was a question whether fewer sorts would not be more economical, for in some cases, although there was a distinction between some of the qualities, it was almost a distinction without a difference. In conclusion Mr. Grimshaw observed that no attempt has been made in the paper to bring forward anything that was absolutely new, but simply to lay before the members of the Society a few facts which might probably lead to useful discussion.

The Chairman observed that he had listened with great pleasure to the paper, but perhaps it would be better if the discussion was adjourned until the whole paper had been printed. This was assented to, and the usual vote of thanks passed to Messrs. Grimshaw and Phillips.

NEW DETACHING HOOK FOR COLLIERIES.

Mr. Geo. H. Hollingworth read a short paper descriptive of Boom and Sugden's new detaching hook for collieries. He said the subject of detaching hooks was at the present time occupying much attention amongst mine managers, partly because of the prominence given to the subject by a recent fearful accident, and partly because of the interest taken in the subject by Mr. Cross, the late Home Secretary, and the circular sent out in consequence by the Inspector of Mines, but he thought mainly because of the existence generally of a feeling amongst colliery managers that some such safeguard should be adopted. The detaching hook which had recently been patented by Messrs. Isaiah Booth and James Sugden was quite different in principle to any other hook at present in use, and although very ingenious, was quite simple. There was no spring or contrivance liable to get out of order, and to secure lightness and strength it was made of cast steel. During the act of detachment three copper pins, which served to keep the studs in position, must be sheared, but the pins were placed one in advance of the other and the shearing action upon each pin was extended over a height of six times the diameter of the pins, the action being similar to that of a cropping machine, so that the shearing was not perceptible, there being practically no strain. Another important feature was that the hook made what was termed a partial overwind impossible, because, if the engine were stopped and reversed before the box came properly into position for detachment, the studs were forced to return to their former working position, as the box was lowered through the suspension beam by an attachment action, the converse of detachment. When the cage has been detached by an overwind the connection of the rope to the cage and the resumption of winding need not occupy more than five minutes. The weight of the hook, the ultimate strength of which was 60 tons, and working load 5 tons, was 38 lb. The hook was not adapted for pits working without guides or with round ropes, as it was necessary that the box should enter square into the suspension orifice. Being only a recent introduction only a few of these hooks had yet been made, but one had been in full working at the Oak Colliery for more than three months, and on being tried by an intentional overwind succeeded perfectly. Experiments having been shown with the hook,

Mr. J. Aitken, who had taken the chair, said there was no doubt that a thoroughly good detaching hook would be the means of saving many lives and much property at collieries. This was not a matter which he understood much about himself, but he thought the hook which had been described was not quite so simple as he could wish.

Mr. Woodward said it appeared to be a very clever mechanical contrivance and there was only one point to which he should object and that was with regard to the swivel, which was always a source of danger. If kept in good order he thought the hook ought to act well.

Mr. J. Rice thought the studs might be liable to rust tight and break off; these kind of hooks ought to be so arranged that they could not get out of order.

Mr. J. S. Martin, assistant inspector of mines, said several kinds of detaching hooks have been invented of late years, many of them similar in principle, but the present one seemed to be quite different in some points. They were all more or less dependent upon a pin, and like every thing else they required attention; but with the ordinary attention which was given at collieries to all kinds of machinery, he did not see any reason why the pin itself should be a cause of accident. He was informed that at collieries where detaching hooks were in use they had, in case of overwinds, been found to act successfully, and had saved a great deal of time, and in some instances, no doubt, lives. There was no instance he knew of in which a detaching hook had been the cause of an accident. In that district he might add that, as the result partly of the circular which had been sent out, here were now 200 detaching hooks in use.

Mr. Hollingworth, in replying to the discussion, said the swivel was not an essential part of the hook and he did not think the hook was liable to get out of order or to set fast.

COAL-MEASURES IN THE SADDLEWORTH DISTRICT.

Mr. William Watts read a paper illustrated by sections giving an account of the geological strata passed through in a tunnel for waterworks purposes at Saddleworth. After giving a description of the modes of sinking, driving and ventilating, the reader observed, with regard to ventilation, that if it was to be effective in a tunnel more than 200 yards away from the shaft, the air-pipe must be made to give out jets of air at intervals of about six yards, as he considered the present system of sending all the air to the face to be faulty, because when the current was very strong it had a tendency to blow out the lights and starve the men, the result of which was that the fans had to be slackened in speed, and the ventilation, as a consequence, suffered. Proceeding to a description of the strata passed through, Mr. Watts observed that they were much disturbed from their natural position, and occasionally the dip was found reversed. In the strata three thin seams of coal were met with, in fact coal was found in five places, including the sinking of the shafts; but it was probable that only two seams existed, both of which were of infetior quality, burned with a dull red, and were very sulphurous. Some of the coal near the Marsh Bottom did not appear to have the usual well-defined floor-clay, and it was probable that if it existed it was rotten, owing to its proximity to the surface, and being acted upon by the surface percolation. The next seam was about 120 yards from the first shaft, in the direction of Marsh Bottom entrance. The floor-clay was present in this instance, but it was very soft and shaken, the overlying coal being all of a lustrous character and much fractured, its component parts having apparently been considerably broken up since deposition and hardening. The remaining seam existed some 300 yards from Hanging Lees entrance, and dipped towards Picthorne Valley at an inclination of about one in six, it measured about 10 inches in thickness, but was of inferior quality and was supported by a hard fire-clay floor. None of the coal-seams passed through in the excavations possessed any industrial value, so that there was no prospect of their being worked in the future owing to the inferior quality of the coal and the thinness of the seams. He was unable to correlate these coal seams satisfactorily to himself, but if he might venture an opinion he would say that they belonged to "the first coal series" found immediately above the Millstone grits, as described by Professor Hill in his "Memoirs of the Geological Survey."

The usual vote of thanks was passed to Mr. Hill for his paper, and the proceedings were brought to a close.

LIVERPOOL ENGINEERING SOCIETY.

THE usual fortnightly meeting of this society was held on Wednesday, 19th inst., at the Royal Institution, Colquitt Street, Mr. Alexander Ross, President, in the chair, when a paper was read by Mr. Window, assistant surveyor to the West Derby Local Board, entitled "Remarks on the Construction and Maintenance of Highways." The author treated his subject rather as a discussion than in a partisan point of view, commencing with a sketch of the highway of Great Britain previous to the renewal of the art of road making. The first great road makers were the Romans, who laid down their vias with rigid foundations, employing both hand pitched stone and lime concrete substructures, the latter chiefly in France. These roads were so admirably constructed that they have in many instances defied the ravages of fifteen centuries. Their peculiarity was the straightness arising from the fact of their being suited to the vehicles of those times, which were without movable axles. After giving instances of the dangerous and neglected state of the roads till the advent of Telford and Macadam, the author went on to say that the state of things described was not even yet quite a matter of history, citing as a proof some private streets in a large borough town where he had seen, previous to their being taken over by the Corporation, mud in the road to the depth of eighteen inches, and alluding to the state of the tram lines on Clapham Road last Christmas time after the thaw. The various methods of constructing roads, including the use of lime concrete foundations, were next commented on. Of materials for road metal Gurensey granite, Penmaenmaur and Clu-Hell-Dhu stone were recommended, and for footpaths, where stone was not cheap and easily obtained, the use of concrete flags, which have been found to answer very satisfactorily in towns where they have been laid down. The preparation and laying down of compressed asphalte was explained. Val de Travers and Limmer and Seyssel being real or mineral asphaltes, and most others artificial compositions. As regards wood pavement it was stated that Henson's appeared to have given satisfaction wherever it had been tried. In a comparison between the respective advantages of wood and asphalte, it was remarked that asphalte appeared to be the smoothest, driest, cleanest, best as regards repair, and possibly longest lived—wood the quietest, and one which afforded the easiest and safest pavement for horses, and the best adapted for gradients. Finally, the author insisted on the paramount necessity of thoroughly hard foundations for all roads except when they crossed marshy districts; the early failures of the Improved Wood Company's pavements being chiefly attributable to mistaken ideas as to the advantage of elasticity in distributing the weight of the traffic, and giving an easier traction surface.

A discussion followed, and the author was accorded a hearty vote of thanks for his interesting paper. The meeting was then adjourned for the summer recess until the autumn.

Agricultural Engineers' Association.—The annual meeting of this association was held on Tuesday last week at the offices, 7, Westminster Chambers, Victoria Street, S.W., Mr. James Howard, M.P., the president, in the chair. The annual report and treasurer's statement were presented and adopted. Mr. Robert Fowler was elected president for the ensuing year, and Mr. James Hornsby and Mr. J. T. Griffin were elected vice-presidents. A paper upon "Cost Prices" was read by the president, and was followed by an interesting discussion. A vote of thanks to the retiring president terminated the proceedings.

Proposed Exhibition of Gas Apparatus at Glasgow.—A meeting of the General Committee appointed by the Glasgow Philosophical Society for the purpose of promoting an exhibition of apparatus for the utilisation of gas and electricity was held on Tuesday last week, Dr. Fergus, the Chairman of the Society presided, and briefly stated the object of the meeting. It was proposed to the Philosophical Society by various parties that it would be a right and proper thing that a gas exhibition should be held in Glasgow. The Philosophical Society, after consideration, concurred in this view, but they were of opinion that it should not merely be confined to an exhibition of gas. They therefore proposed that the exhibition should be under the following heads.—Gas (manufacture, storage, distribution, measurement, regulation of pressure, and quality), lighting, heating stoves, cooking stoves, engines of all kinds, paraffin oils, candles, &c., gasoline machines, electric lighting, electric engines, electric communication, telephonic communication, photometric apparatus, products of gas manufacture, dyes, ammonia, salts, &c. Dr. Wallace, seconded by Dr. Muirhead, then nominated a large executive committee, with Dr. Fergus as chairman, Mr. Foulis and Dr. Wallace as vice-chairmen, and Mr. Mann as secretary and treasurer. Some discussion followed on the question of awards to the various exhibits, and a recommendation was adopted to the effect that it was desirable that awards, in the shape of medals or certificates, or in such other form as might be agreed on, should be given to the most meritorious of the apparatus sent forward. The question of site was also raised, and Mr. Kirsop suggested that application should be made to the Town Council for the use of the ground in George Square, if it was still vacant at the date of the exhibition.

School of Art Wood-carving.—One free studentship in the day and four in the evening classes of the School of Art Wood-carving at the Royal Albert Hall, Kensington, are at present vacant. These studentship are maintained out of the funds provided by the City and Guilds of London Institute for the Advancement of Technical Education. Forms of applications and prospectuses of the School may be obtained by letter addressed to the Secretary, School of Art Wood-carving. Royal Albert Hall, Kensington, S.W.

Technical Education in Yorkshire.—The ceremonial opening of the new Textile Industries and Dyeing Departments of the Yorkshire College, Leeds, erected at the cost of nearly £15,000 by the Clothworkers' Company, has been postponed until October next; but in the meanwhile the work of the various classes have been organised and commenced. The laying of the memorial stone of the new Technical School at Bradford is to take place on June 16. The cost of the building and site will exceed £15,000, towards which the Clothworkers' Company subscribe £3000. A new building for the Technical School at Huddersfield will shortly be commenced. Ten thousand pounds and upwards have already been subscribed or promised by the merchants and manufacturers of the town and neighbourhood, and to this the Clothworkers' Company have just promised an addition of £2000.—*City Press.*

The Royal Agricultural Society.—The preparations for the annual exhibition of the Royal Agricultural Society, to be held at Carlisle in July next, are making rapid progress. The show-yard will be upon the meadows in front of Carlisle Castle, called the Saucerles. Workmen having been in possession of the ground for several months, the enclosure has been made, and the framework of the shedding is far advanced towards completion. There will be in all rather under 10,000 feet of shedding in the implement yard. The space allotted to machinery in motion and seeds and models will be as great as is usual at the country shows of the society, but the shedding required for the miscellaneous implements (6662 feet) will occupy only about half of the space allotted to that department at Bristol, Birmingham and Liverpool, the effort of the council to reduce the extent of the exhibition of non-agricultural articles by increasing the price charged for the ground having had the desired effect. The show of horses will be the largest the Society has ever had, except at Kilburn last year, 487 having been entered. The entries of cattle, sheep, and pigs are fully up to the average of the larger country meetings of the Society. The implement yard is to open on Saturday, the 10th of July, and the stock yard will be thrown open to the public on the following Monday, July 12th.

Continental Exhibitions.—An exhibitant of articles connected with the watch and clock trades will be open at Geneva during the latter part of May, June and July. It will be divided into five groups, devoted respectively to the raw material, the skilled labour of the workshop, instruments of mensuration and calculation, motive force and transmission, and tools and mechanical contrivances. The rewards at the close of the exhibition will consist of diplomas.—On the 9th inst. there was opened at Dusseldorf an exhibition of the industrial products of the whole Rhine country of Westphalia and some of the neighbouring departments. A German exhibition of fine arts is also open, and will attract public attention beyond the limits of Germany. German artists have responded very zealously to the invitation of the administration of the German Artists' Association, a society which influences both Germany and Austria. Many artists of European fame are represented by works of the highest merit, about 1600 pictures, drawings, and engravings and 80 sculptures being exhibited. No doubt not only German, but also foreign tourists, in visiting the Rhine this summer, will take the opportunity of making the acquaintance with this show of the products of German art in one of its most considerable centres. Another kind of interest will especially attract the attention of English and other foreign visitors to the industrial part of the exhibition. The trades, manufactures and industries of Germany have not attained the same degree of perfection and celebrity as the fine arts of that country. Indeed, many branches of German industry are still in a state of evolution. However, the crisis of the last few years, which pressed heavily on it, will give additional interest to the first great attempt to concentrate the industrial forces of the country. Dusseldorf is in the heart of the industrial districts of Germany. Mining and smelting are there amply represented, and the weaving industry of some of the Rhenish towns is very considerable. These and all other trades have greatly contributed to the show, the number of exhibitors in the industrial department alone being more than 2500. As has already been announced the members of the Iron and Steel Institute have decided to hold their annual meeting this year at Dusseldorf. The exhibition willcontinue open until the beginning of October.—An exhibition will be held in July at Perugia, under the sanction of the Italian Minister of Agriculture and Commerce, of agricultural machinery, in which prominence will be given to steam ploughing and cultivation. In 1881 there will be one of the same character at Lucerne, while Germany will hold two in the year—one at Frankfort, of hides, skins, tanning, and fur trades, the other probably at Berlin, of all apparatus connected with baths and electric treatment of disease.

MEETINGS FOR THE WEEK.

MONDAY, May 24.

Royal Institute of British Architects.—8 p.m. 1. Discussion on Iron as a Material for Architectural Construction. 2. Professor A. B. W. Kennedy, on Mild Steel and its Application to Building Purposes.

TUESDAY, May 25.

Mansion House.—8 p.m. Fine Art Conversazione.

Institution of Civil Engineers.—8 p.m. Concluding Meeting. Discussion on Portland Cement and Portland Cement Concrete.

WEDNESDAY, May 26.

Society of Telegraph Engineers.—8 p.m. Mr. E. Graves, on a Decade in the History of English Telegraphy.

Geological Society.—8 p.m.

THURSDAY, May 27.

Royal Society.—4.30 p.m.

Municipal Engineers' Association.—Annual Meeting at Leeds. (Three days).

Association of Municipal and Sanitary Engineers.—Meeting at Leeds. (Three days).

FRIDAY, May 28.

Architectural Association.—7.30 p.m. Mr. W. Scott, on Some Italian Architects.

Royal United Service Institution.—3 p.m. Major-General Sir Michael A. Biddulph, on the March of the Quetta Column from the Indus to the Helmund River and back.

SATURDAY, May 29.

Geologists' Association.—10.15 a.m. Excursion to Aylesbury.

METALLURGY AND MINING.

THE ROYAL COMMISSION ON ACCIDENTS IN MINES, IN SOUTH YORKSHIRE.

YESTERDAY morning, in accordance with arrangement, the members of the Royal Commission on Accidents in Mines left Barnsley Midland Station in a special train for the purpose of visiting Strafford, New and Old Oaks Collieries, South Yorkshire. They were accompanied by Mr. Wardel, Inspector, Mr. Gerrard, Assistant Inspector of Mines for Yorkshire, together with President and Secretary of the Midland Institute of Mining Engineers, and Mr. Embleton, mining engineer. The object of the visit is an inspection of collieries where sudden outbursts of gas have occurred.

It may be stated that the Committee have taken the whole of the evidence they require in London, and have since that time visited Scotland, Wales and South Staffordshire, more with a view of seeing the working of the coal, which in some districts differs very materially. As before intimated, the chief object of the Commission in the district was to visit collieries where these sudden outbursts have occurred, totally baffling all ventilation. The Committee, after arriving at Barnsley, were met by Mr. F. N. Wardel, Her Majesty's Inspector of Mines for Yorkshire, Mr. T. W. Embleton, mining engineer, and Mr. R. Carter, president of the Midland Institute of Mining Engineers. Arrangements were made for a special train to convey them to the Strafford Colliery, where they were met by Mr. J. Warrington, one of the managing directors, and Mr. R. Miller, the resident manager, who is also a member of the Midland Institute and North of England Institute of Mining Engineers.

The colliery deserves more than a passing notice on account of several serious outbursts having occurred in the Silkstone seam. It was sunk about twenty-four years ago by Messrs. Smith, Carr and Smith, and a few years later was converted into the Strafford Collieries Company. The shafts are sunk nearly three miles South of Barnsley, on the estate of F. W. T. V. Wentworth, Esq., and has an extensive royalty of the Silkstone, Parkgate, and Flockton seams of coal, and is connected with the South Yorkshire branch of the Manchester, Sheffield and Lincolnshire Railway from Wombwell. There are five shafts all on one extensive and roomy pit heap, drawing from a depth of 240 yards. The mode of ventilation is by a guibal fan 36 feet diameter, and the whole of the works are laid out with every improvement of the most modern character, there being a pair of haulage engines underground for hauling the coal to the pit bottom. Referring to the more immediate object of the visit, attention was called to a trace of a serious outburst of gas in the Silkstone seam, about 650 yards from the pit bottom. For some time a pressure gauge was placed over a bore hole, and at the time of the visit of the North of England Mining Engineers in 1875, the gauge was standing at 124 lb. to the square inch. The gas was stopped in the presence of the visitors, and on being put on again it rose to 100 lb. to the square inch. The first outburst occurred in the Silkstone seam on the 1st of October, 1867, and was carefully noted by the manager. A second outburst occurred on the 31st of August, 1870. Their occurrences are officially described. The Silkstone seam in which the issue occurred is 246 yards deep, and nearly 6 feet in thickness, including 8 metres of coarse coal which is generally left on the bottom. The roof is a moderately hard bind of blue metal. The outburst in both instances came from the strata below the coal. The system of the works and ventilation are on the long wall, with packgates and working a board face to the rise about one in nine. In the first case, the men working in No. 9 and No. 10 gateways heard the faces and timbering near where they were working on the weight for several hours. About half-past six o'clock next morning eight men were working in banks when all their lamps fired and went out. Two men who were working near felt a rush of air and dust, and extinguishing their lamps escaped. A number of other men working on the return side of the crack had their lamps extinguished and made their escape. The current of air on the face from the crack together with some scales in two gates made 7000 feet per minute at one point, and this was further increased by 4500 feet up No. 3 jennygate, making 11,500 feet per minute, and at a velocity of 360 feet per minute from top of No. 3 jennygate, meeting another current of 5500 feet from the south side. There was no doubt that the gas extinguished the lamps with a current of 11,500 feet, and a velocity of 360 feet per minute. Several trimmers who were at work in a part where a current of 11,500 feet, and at a velocity of 360 feet per minute were passing had their Stephenson's lamps fired and extinguished. The whole of the returns were not examined until six hours after the occurrence, and the lamp that fired on the floor and near the roof. The second outburst occurred on the 31st August, 1870. From the floor it was less violent, but enough to foul a strong current of air being 10,000 to 12,000 feet per minute on the face to where it joined, with 8000 feet per minute more for at least four hours after first coming off.

After leaving the Strafford Collieries the Committee visited the Oaks Collieries where several alarming outbursts have occurred, and where in December, 1866, 360 persons perished by a series of explosions. The Old Oaks has been worked for many years, but the new pit was only sunk in 1867, after the sad explosion, in order to afford additional ventilation. Here the Barnsley seam is worked at a depth of 285 yards in the old pit. At the latter pit Stephenson's, Clanny and Mueseler's chimney lamps were used in August, 1876, when an outburst occurred, and the intake current was reversed for a brief period, at a point about 600 yards on the out bye side of a bank, and at about the same time the safety lamps at the bottom of the upshaft were fired or extinguished by the gas, though a current of return air, equal to 140,000 cubic feet per minute in an area of 104 feet, was passing at the time. The sudden outburst of gas caused a large fracture in the floor. At Old Oaks on the day of the outburst in 1877, about 11 p.m., gas made its appearance, and on the arrival of the deputy he found the gas had backed against the intake air; and some hours after the workings, which were ventilated by a current of 10,000 cubic feet of air per minute, were fit for work on the banks, and straight work places being examined, it was found that the props were displaced and the floor of the coal lifted up 2 feet. On the 8th September, 1877, another outburst occurred, but the men were withdrawn, and two hours later it was found that the floor was lifted up 2 feet, and the props in the bank were thrust out. The current of air passing at the time was 9000 feet per minute. A third occurrence of a like nature happened on 30th November, 1877. A man who was making a hole in the floor to fix a prop found gas issuing therefrom, and before he and his companions could retire their lamps were extinguished. The gas in some parts of the pit continued for four hours and filled all the boards, although the ventilating current was 13,000 cubic feet per minute.

Other collieries in the district were set down to be visited, but the Committee will consider whether they have occasion to go over them.

Australian Gold Mining.—At the close of the year 1879 there were in the colony of Victoria nineteen mining shafts sunk to the depths of over 1000 feet, eleven of them being at Stawell, in the Ararat district, five at Sandhurst, two at Clunes, and one at Tarrengower. The deepest shafts were those of the Magdala, 2273 feet; Newington 1940; and Prince Patrick, 1730 feet. There were 37,553 miners employed in Victoria in the last quarter of the year 1879, of whom 28,443 were Europeans and 9110 Chinese.

Steel in Carriage Building.—The substitution of the steel for iron has made another step in advance, and in a direction where, if the hopes of the inventors are justified by the result, we may expect to see considerable changes. Hitherto the metal work of our ordinary driving carriages has been wholly iron—except in those instances where the partial introduction of steel took the place of any additional ornament. A well-known metropolitan coachbuilding firm has now on view the specimen of a carriage built wholly with steel—springs, tire, framework, &c.; and it is calculated that the saving in weight will be nearly five-and-twenty per cent., with possibly better results in the future; whilst for supporting wear and tear the preference for steel over iron will, when its advantages are known, be as strongly endorsed by owners of carriages as they now are by directors and managers of railroads.

Important Colliery Enterprise.—The Naval Steam Coal Company Penygraig have for some months been using their utmost efforts to effect a communication, for purposes of ventilation, between their two shafts, respectively 420 and 430 yards deep. The distance between the pits is 1300 yards, and though the borings at the "faces" have been heard for some weeks, the men were only able to strike through at twelve o'clock on Thursday night last week. The ground was so accurately surveyed by Mr. M. R. Rowlands, that when the last shot was fired the men on either side found themselves face to face. About midway an anticipated fault, of considerable dimensions, was met, and at the bottom of this, in the lower pit, the celebrated nine-feet seam was won, evidently thrown up by the fault. The great distance between the shafts, so successfully driven through without the loss of a single life, will enable the managers to open up a comparatively large range of work without delay, thus giving employment immediately to several hundreds of additional men.

VICTORIAN GOLD MINES.—The report of the Government Mining Surveyor for the colony of Victoria has just been issued, showing that for the quarter ending December 31st the quantity of gold obtained was 219,411 oz., of which 79,333 was from alluvium and 129,678 from quartz. The exportation of gold produced in the colony was 83,700 oz., and the amount received at the Mint was 136,296 oz. As to the numbers engaged in mining, there were altogether 37,553, of whom 13,824 Europeans and 8945 Chinese were occupied in alluvial mining, and 14,619 Europeans and 165 Chinese in quartz mining. The Ballarat district heads the list with 8218; Maryborough, 7800; Sandhurst, 6423; Beechworth, 5066; Castlemaine, 4805; Ararat, 2947; Gipps Land, 2294. The square miles of auriferous ground actually worked upon were 1324, of which Beechworth district had the greatest share—340 miles. The number of quartz reefs actually proved was 3582, of which Beechworth possessed 865, Sandhurst 772, Maryborough 613, Gipps Land 501, Castlemaine 404, Ballarat 347, and Ararat only 80. Some of the shafts sunk in the colony (in the aggregate 19) are over 1000 feet in depth, the Magdala shaft in the Ararat district, being 2273 feet, and the Newington 1940 feet. The approximate value of all the mining plant in the colony was £1,899,788, of which Ballarat held £379,325.

IMPORTANT NEW COAL-WINNING NEAR MANCHESTER.—During the last five years mining operations have been carried on at Ashton Moss, near Manchester, for the purpose of winning the valuable seams of coal which lie under that district. A short description of the work, so far as it had then proceeded, was some time back given in these columns, and, as already reported, two shafts had already been sunk to a depth of about 700 yards when some doubt arose as to the actual position in which the seams sought for would be found, and the work of sinking was suspended. Boring operations were then commenced, and these have been continued during the past six months by means of Vivians boring apparatus until they have now been carried to a further depth of about 260 yards below the shafts already sunk. The result has been that several seams of coal, varying in thickness from 2 feet 6 inches to 6 feet 4 inches have been proved, some of these being of first-class quality, both for house-fire and steam purposes, whilst the position in which the coal has been found justifies the belief that the measures worked at the Lord's Field Colliery, nearly two miles distant on the rise of the new shafts, are continuous between the two points. The other boundaries of the coal-field would appear to be: On the western side, the fault passing in a north-westerly direction through Droylsden; on the northern side, the great fault separating the Ashton from the Oldham coalfields; and on the southern side, the faults which are encountered by the northern limits of the Denton Collieries. It will thus be seen that a very considerable area of coal will be opened out by the new colliery, and the proved existence of valuable seams in the above district is a fact of considerable importance to the manufacturing centres of Ashton and Staleybridge, and to the numerous works on the eastern side of Manchester, which will thus be placed within easy reach of a largely increased supply of fuel suitable for manufacturing purposes. The actual depth at which the seams will be worked having now been proved, and the engineers having thus been able to decide upon the strength and class of machinery which will be required, the sinking of the shafts has been resumed, and it is expected that operations will now proceed without further interruption. The owners of the colliery which is being sunk, and which situate as it is within readily available means of communication, both by railway and canal, has every prospect of proving a successful undertaking, are Lord Stamford and Messrs. B. Whitworth, Walker and Greenwood, and the work has been carried on under the superintendence of Mr. John Higson, of Messrs. J. and P. Higson, civil and mining engineers, Manchester, Mr. Greenwood being the resident mining engineer at the colliery.

EXTRAORDINARY DEVELOPMENT OF THE COKE MANUFACTURE.—No department connected with Yorkshire mining operations forms a more important feature of the trade at the present time than the production of coke, and it may safely be said that during the past four or five months it has been about the only adjunct of the business from which any profit has been derived. The sudden revival in the iron trade which set in towards the close of September last gave an impetus to smelting operations and soon told upon makers of coke. Previous to the change owners of collieries had been sorely perplexed with respect to their slack and small coal, so that they readily availed themselves of any system which would enable them to turn it to profitable account. It is, however, to be feared that its best days have been numbered, for already prices have declined whilst the output has been already far more than doubled throughout Yorkshire alone. Like all other branches of trade the making of coke has during the past few years undergone considerable and important alterations. Veterans in the coal trade can remember the time when in the early progress of the railway system, coal having to be discontinued as a generator of steam owing to the engines making too much smoke, the railway companies had to pay 1s. per ton for it being burned into coke in the South Yorkshire district. The appliances, however, in those days were very different to what are in use now. During the past few years large sums of money have been expended in putting down machinery for washing the coal before it is placed on the ovens, and providing appliances for filling and drawing them. In this way South Yorkshire colliery proprietors have become keen competitors with Durham and North of England coke makers in North Lincolnshire and other iron smelting districts. The number of ovens now at work in South Yorkshire is very much larger than at any previous period in the history of mining operations. It is estimated that there are now twelve firms who are working close upon 1000 ovens, and at some places, such as Church Lane, East Gawber and Wharncliffe Carlton Collieries, from 500 to 600 tons per week are turned out. The Silkstone and Dodworth Iron and Coal Company (Limited) have over 100 ovens at work, and in a short time they will blow in two large blast-furnaces at Wingfield, in Derbyshire, which will consume a good deal of what they make. At the New and Old Oaks Collieries a large output of capital coke is made weekly, and is for the most part, if not entirely, consumed by the owners of the collieries, Messrs. Cammell and Co. (Limited), at their works at Sheffield and Penistone. A very good tonnage, amounting to from 60 to 70 tons per week, is being turned out in the North Gawber Hall Collieries (Limited) where over £1000 was expended last half-year in new ovens, whilst twenty-eight additional ones are in course of construction. The four long ranges of ovens at Silkstone Common near Barnsley, erected many years ago by the Frodingham Iron Company, and which are now being worked by a local firm, are now in full blast, whilst about a score of others are in a forward state of repair and will shortly be ready for work if they are needed. The ovens at the collieries belonging to Earl Fitzwilliam are in full operation, as are those at other places. It may also be stated that at the Manvers Main Colliery, between Wombwell and Wath, a large number are in course of erection. At the Mitchell's Main Colliery a number are also being built, and this is the case at Thorncliffe, where Mr. Chambers' patent is being turned to account at a number of new ones, whilst many old standards have also been fitted with the new invention, workmen have also been recently engaged in Wales and Derbyshire fitting the patent to old ovens. It will thus be seen that this important branch of trade presents great activity, but the large output, together with the vast increase which will shortly take place when the ovens in course of erection and those contracted for are at work, seem to bid fair to overstock the market. One important point, however, ought not to be overlooked, that whilst Yorkshire coalowners possess a splendid coking coal and have greatly improved their make by washing and grinding, they are able to reach the North Lincolnshire iron-smelting district by rail at about 2s. per ton, whilst the tonnage rates from the North of England range from 6s. to 7s. per ton.

SANITARY, ENGINEERING, GAS AND WATER, &C.

SOCIETY OF ARTS CONFERENCE.—The conference which has been held annually since 1876 by the Society of Arts on subjects connected with public health is announced for the 10th and 11th of June. As in former years, Mr. Stansfeld, M.P., will preside. The programme is arranged in three divisions, the first of which deals with sanitary administration and organisation. The first point taken up under this head refers to the constitution of county boards chargeable with the conservation of rivers, the appointment of county health superintendents, &c.; the second sub-division relates to the formation and regulation of sanitary districts; the third, to the method by which members should be elected on the county boards; and the fourth, to the method of inspection which, it is suggested, the Local Government Board might adopt. The second main division of the programme relates to the amendment of the law—(1) the Public Health Act, 1875; and (2) the Pollution of Rivers Act, 1876. The third main head refers to a proposal for a sanitary inspection and classification of dwellings.

THE THAMES CONSERVATORS AND THE BOARD OF WORKS.—The report and determination of Captain Douglas Galton, C.B., F.R.S., and Frederick Joseph Bramwell, F.R.S., M.Inst.C.E., appointed in June, 1879, by the Conservators of the Thames and the Metropolitan Board of Works respectively to arbitrate with regard to certain differences between the two bodies as to whether certain banks in the rivers have arisen from the flow of sewage at the outfalls, and as to whether they are an obstruction to the navigation of the river, has been published. The arbitrators were appointed under the Thames Navigation Act of 1870, and the banks in question are the Margaretness Bank, Barking Bank, and Crossness Bank. Associated with the arbitrators was Sir C. A. Hartley, F.R.S.E., M.Inst.C.E., as umpire, and who entirely concurs with the decision of the arbitrators. The decision is as follows:—"That the Barking and Halfway Reaches, where the three banks are situated, are now better for navigation than they were before the Outfalls were opened; but at low water sailing vessels of a certain draft cannot make as long 'boards' when tacking to beat up or down the river as they could before the banks came into existence. In this limited sense only do we determine the banks to be obstructions to the navigation. That each of the three banks has arisen from the dredging operations in Barking and Halfway Reaches carried on by the Conservators of the Thames or sanctioned by them, such dredging operations having removed material and having increased the sectional area of the river, and altered the direction of the flow of the currents and tide, so as to produce a diminished velocity in those parts of the Reaches where the banks are situated, thereby causing a deposition of matter suspended in the river, and the formation of the three banks. That the water in the tidal portion of the Thames contains a considerable amount of suspended matter, derived partly from the basins of the Thames and its tributaries, partly from the washing away of the foreshores of the tidal estuary, where unprotected, partly from material brought up from the mouth of the river by the flood tide, partly from sand and mud stirred up in the course of dredging operations, partly from denudation of the river bed, partly from sewers in districts outside the metropolitan area, and partly from the sewers of the Metropolitan Board. The proportion contributed from this latter source is small compared with the amount of suspended matter in the whole volume of tidal water which flows past the outfalls on every tide. That the three banks are composed of matter which had been held in suspension in the water, and had been derived from the several sources above mentioned. Whilst, therefore, the sewage from the metropolitan outfalls may have contributed to their contents, the three banks cannot be said, in the sense of the Act of 1870, to have arisen from the flow of sewage at the outfalls; and we are, therefore, of opinion that the Metropolitan Board of Works should not be called on to remove, or contribute any portion of the expense of removing, the three banks or any of them. That the Conservators and the Metropolitan Board of Works do each bear their own costs of the reference, and pay one-half the costs of this report and determination."

RAILWAYS & TRAMWAYS.

NOVEL RAILWAY ENTERPRISE.—The Great-Eastern Railway Company are about to adopt a service for supplying salt water at any house within the ordinary cartage delivery of the Company in London or the country. The water will be conveyed from Lowestoft and delivered in three gallon cans at 6d. each, to include delivery and the collection of cans when emptied.

THE NORTH METROPOLITAN TRAMWAYS COMPANY.—This Company which has just entered its eleventh year of existence, carried from and to the City on Whit-Monday the enormous number of 154,925 passengers. To cope the requirements of the day the Company ran 190 cars, employed 2070 horses, and ran 1841 double journeys. The receipts reached £1421, being the largest amount yet earned by the Company in one day.

NEW RAILWAY.—A new rail from Oldham to Manchester via Hollinwood was opened on Monday morning. The line so to speak, will bring Oldham and Manchester three-quarters of a mile nearer, and will open up direct communication with Hollinwood and Newton-heath. The line is between four and five miles in length, and has cost about as much per mile as any line in the kingdom, many difficulties having had to be encountered.

NEW TRAM-CAR ROUTE.—A new tram-car route in the north-western suburbs of the metropolis, having been duly inspected by the officials of the Board of Works and the Metropolitan Board of Works, was opened for passenger traffic last week. It extended from the corner of Kentish Town Road westward along the Prince of Wales's Road, and then turns sharply north opposite the Mother Shipton tavern at the foot of the Malden Road, which it traverses at full length, nearly to the foot of Haverstock Hill. Opposite the new Dominican monastery it again turns along the Southampton Road, and has its terminus a little short of the Fleet Road, not far from the "Gospel Oak," which used to mark the boundaries of the parishes of St. Pancras and St. John's, Hampstead.

NAVAL ARCHITECTURE.

LAUNCHES.

ENGLISH.

Adelaide.—On the 8th May, the *Adelaide*, a steel paddle steamer, intended for the Great Eastern Railway Company's Harwich route to the Continent, was launched from the yard of the Barrow Shipbuilding Company. The dimensions of the *Adelaide* are:—Length 260 feet, beam 32 feet, with a gross tonnage of 960 tons, and accommodation for nearly 200 passengers. She is fitted with compound oscillating surface-condensing engines of 1600 indicated horse-power. She is expected to be running between Harwich and the Continent next month.

Albert Victor.—On May 10th the *Albert Victor*, steel paddle-wheel steamer, was launched by Messrs. Samuda Brothers, at Poplar. This vessel has been built for the South-Eastern Railway Company for the service between Folkestone and Boulogne, and has been constructed of steel manufactured by the Siemens process. The engines, by Messrs. Penn of Greenwich, are of 2800 horse-power, and will be fitted with steam starting gear and other recent improvements. The vessel's principal dimensions are:—Length, 250 feet; breadth, 29 feet; depth, 15 feet 6 inches; burthen in tons, builders' measurement, 1040 tons.

Barnesmore.—On May 8th the screw-steamer *Barnesmore* was launched by Messrs. Thomas Royden and Sons, Queen's Dock, Liverpool. She is a vessel of about 2000 tons, and has been built to the order of Messrs. William Johnson and Co., to trade between Liverpool and the Danubian ports. Her principal dimensions are:—Length, 260 feet; breadth, 34 feet; and depth of hold, 18 feet 6 inches. This steamer, which is classed for 20 years in the Liverpool book, will be supplied with engines of 150 horse-power, constructed by Messrs. Jack and Co., of the Victoria Engine Works, Liverpool.

Drift.—On the 6th May there was launched from the building yard of Mr. Thomas Sandry, of Porthleven, a yacht of the same style of build as the first-class mackerel drift-boats of the Mount's Bay. She is owned by Mr. C. Clarke, of Plymouth. She is built of oak timbers, and pitch pine planks, of the following dimensions:—Length of keel, 40½ feet; overall, 45 feet; depth, 8 feet 2 inches; beam, 13 feet without, and is lug rigged. Her cabin and internal fittings are to be put in at Plymouth. She is named *Drift*, and will carry the flag of the Thames Royal Yacht Club.

Elfie and *Gulf of Suez.*—On the 8th May, Messrs. W. Gray and Co. launched at West Hartlepool two screw-steamers. The first was to the order of Messrs. Neilsen and Co., West Hartlepool, and was christened the *Elfie*. She measured 235 feet in length, 32 feet breadth, and 17 feet and 21 feet depth of hold. Her gross tonnage is 1250, and her carrying capacity 1600 tons. Her engines will be 110 horse-power, and are to be supplied by Messrs. Blair and Co., Stockton-on-Tees. The second was to the order of the Greenock Steamship Company. Her dimensions are:—260 feet length, 34 feet breadth, and 23 feet 3 inches depth of hold. The gross tonnage is 1570 tons, and she will class 100 A1 at Lloyd's as a three-decker. Her engines, which are 150 horse-power, will be by Messrs. Blair and Co., of Stockton, and she will form one of the line trading out of the Clyde. She was christened the *Gulf of Suez*.

John Chagot.—On May 6th the *John Chagot* (s) was launched from the yard of the Palmer Shipbuilding Company, Jarrow. She is a vessel measuring 230 feet between perpendiculars; 32 feet breadth moulded; and 17½ feet depth of hold. She is classed 100 A 1 at Lloyd's, being built under special survey. She will be schooner rigged, and have a long, raised quarter-deck. Her engines will be 130-horse power nominal, and manufactured by Messrs. Palmer.

Marion.—On May 11th the *Marion* a screw-steamer, built to the order of Messrs. James Gray and Co., of Whitby, was launched from the shipbuilding yard of Messrs. Joseph L. Thompson and Sons, North Sands, Sunderland. The steamer is of the following dimensions, viz.:—Length, 278 feet; breadth, 35 feet; depth of hold, 24 feet; and of 2800 tons burthen; built under special survey, on the three-deck principle, to class 100 A at Lloyd's. This vessel has full poop, long bridge house, and full topgallant forecastle; the main and bridge decks are of iron. The engines, which are on the compound surface-condensing principle, are being fitted by Mr. John Dickinson, of Palmer-hill Engine Works, Sunderland. The *Marion* will be schooner-rigged, the lower masts being of iron. Four horizontal steam winches will be fitted, also patent windlass and patent steam steering gear, and other modern improvements for securing economy and dispatch. She is intended for the American and Indian trades.

Tangier.—On the 11th May, there was launched from the ship yard of Messrs. Raylton, Dixon and Co., an iron steamship, named the *Tangier*, which has been built to the order of Messrs. Angier Brothers, of London, and is especially intended for the American trade. Her dimensions are: 278 feet long, by 35 feet 3 inches beam, by 24 feet 6 inches depth of hold; she has iron main-deck, wooden sheathed upper deck, and a third tier of beams, water ballast in after hold, and under engine-room, and in large chamber in fore-hold. Her carrying capacity will be about 2800 tons, and she will be fitted with engines of 170-horse power by Messrs. Thomas Richardson and Sons of Hartlepool.

SCOTCH.

Eira.—On the 12th of May a steam-yacht was launched from the building yard of Messrs. Stephen and Forbes, Peterhead, being the first steamer that has been built at the port. The yacht has been built to the order of B. Leigh Smith, Esq., London, and is to be used for private explorations in the Arctic regions and trips to the Northern Seas. The frame of the vessel is of oak, lined outside with iron bark, and she is fitted up internally in a very strong and substantial manner. Her dimensions are—Length of keel, 125 feet; breadth, 25 feet; depth, 12 feet; and probable tonnage, 260 gross. She will be fitted up with compound surface-condensng engines of 50-horse power. As the vessel left the wiays she was named the *Eira*.

Frolic.—On the 7th May, Mr. James Adam launched from his boatbuilding yard, at Gourock, a yacht of the following dimensions:—Length, 25 feet; breadth, 6 feet; and depth, 5 feet. She has been built to the order of Mr. William Adam, Greenock, and will be fitted out at once by her builder. The yacht is named *Frolic*.

Garry.—On the 12th May there was launched from the Caledon shipbuilding yard (Mr. W. B. Thompson's) an iron screw-steamer of 960 tons register. As she left the ways she was named the *Garry*. Her dimensions are:—Length, 218 feet; breadth, 30 feet; depth in hold, 15 feet 6 inches. The steamer has been specially built as a cargo boat. The main deck is of iron, and arrangements are made for taking in water ballast in double bottom and at the ends of the ship. The engines are compound surface-condensing of 98 horse-power nominal. To expedite the loading and discharging of the vessel three horizontal steam winches have been fitted up on board. Steam steering gear has been placed amidships, while aft there is screw steering gear. The steamer is schooner-rigged, and her lower masts are of iron. The *Garry* has been built to the order of Messrs. George Armitstead and Company, and others, and Mr. James Mitchell, shipbroker, Dundee, is managing owner. She will be principally employed in the Baltic and Archangel trades

Malemba.—On the 8th May, there was launched on the Clyde, by Messrs. John Elder and Co., a screw-steamer, sister to the *Coanza*, for the British and African Steam Navigation Company, of Liverpool and Glasgow. She is classed 20 years at the Liverpool Underwriters' Registry; and is named the *Malemba*. Her dimensions are:—Length between perpendiculars, 290 feet; breadth, 36 feet; depth of hold, 18 feet. The vessel is specially designed to have large carrying capacity combined with light draught of water, and is for that reason built entirely of steel. She will thus be enabled to cross the bars which are situated at the entrance of most of the African ports, and save the necessity which at present exists of transhipping the cargo to shallow-draught vessels. The engines, which are being supplied by the same firm, are on their compound principle, with all the latest improvements, and will develop 950-horse power indicated, which will give a speed of about 12 knots an hour. The vessel, although intended principally for cargo, will have good accommodation on deck for about 20 passenger, besides officers, engineers and crew, and will be fitted with steam windlass winches and all the latest improvements.

IRISH.

Whitehead.—On the 5th inst. an iron screw-steamer, named the *Whitehead*, was launched from the shipbuilding yard of Messrs. Harland and Wolff, Queen's Island, Belfast. The steamer is built to the order of the Ulster Steamship Company (Limited), of which Messrs. G. Heyn and Sons, Ulster-Chambers, Belfast, are the managers, and will be engaged in their Baltic and Mediterranean trades, principally in connection with the port of Belfast. The dimensions of the *Whitehead* are:—Depth, 250 feet; breadth, 31 feet 3 inches; depth, 17 feet 6 inches; about 1250 tons gross, and 750 tons net register. The vessel is expected to carry about 1800 tons deadweight. The engines, which are to be supplied by Messrs. James, Howden and Co., of Glasgow, are on the compound surface-condensing principle, with all the latest improvements. They will be about 130 nominal horse-power, the cylinders being 28 inches and 53 inches, with 3 feet 2 inches length of stroke. Steam will be supplied from two boilers with large heating surface, and of superior construction, by the same makers. The hull is built upon the longitudinal bracket system, having a double bottom extending fore and aft, fitted for water ballast, with extra strengthening and bracketed upon every frame. The steamer, which is classed 100 A1 at Lloyd's, will be schooner-rigged, with two iron pole masts. She has four large hatchways, and will be supplied with four powerful steam winches, and every facility for very rapid loading and discharge of cargoes.

TRIAL TRIPS.

Elcano.—This vessel, just completed by Messrs. A. M'Millan and Son, Dumbarton, was down the firth on her trial trip on May 11th. On the measured mile she was tried progressively, and the speed obtained was considered by builders and owners as highly satisfactory. The *Elcano* has been built for the mail and passenger service of Messrs. Olano, Larrinaga and Co., between the islands of the Spanish Philippine dependencies, and is fitted up for a number of first-class passengers. The engines were made by Mr. David Rowan, Glasgow.

Hexham.—On the 12th May, the new screw-steamer *Hexham*, built by Messrs. A Leslie and Co., Hebburn, to the order of Messrs. James Turpie and Partners, North Shields, had her trial trip to sea. She is of the following dimensions:—Length, 260 feet; breadth, 34 feet; depth, 23 feet 6 inches; gross register, 1715 net; 1115 tons. The engines, by the North-Eastern Engineering Company, Sunderland, are 180-horse power nominal. She will be commanded by Captain D. Turpie, and is intended for the East Indian, American, and general trades, for which purposes she has been fitted up in a substantial manner, and has all the latest improvements. After a very enjoyable trip the vessel was brought back to the Tyne to load in Howdon Dock for Port Said, whence she goes to the Madras coast to load for Marseilles.

Lady Tyler (s). — On the 4th May the new iron passenger steamship the *Lady Tyler*, belonging to the Great Eastern Railway Company, and built by Messrs. T. and W. Smith, North Shields, left the Tyne on a trial trip. The vessel was built for the Continental passenger service between Harwich and Rotterdam. She is 200 feet in length, 30 feet in breadth, and 13 feet 6 inches in depth. Her engines, of 350-horse power, are by Messrs. R. and W. Hawthorn, Newcastle. The principal saloon is about 40 feet in length, and accommodation is provided for above 200 first and second class passengers. On the occasion of the trial trip there was a strong swell, and the steamer behaved admirably. After running out to sea some distance she returned to the Tyne about noon.

Neptune.—On the 19th May, the *Neptune*, six, armour-plated turret-ship, went on a six hours' run, in the course of which she took four full-power runs on the measured mile in Stokes Bay. The Controller of the Navy, Sir Houston Stewart, was on board. Though measures had been taken to improve it, the ventilation of the stokehole was very defective, and owing to the high temperature and insufficient draught, it was difficult to keep up the steam. The trial commenced at eleven and finished at five. The mean horse-power developed during the six hours amounted to 7993, and the revolutions of the engines per minute numbered 61; the mean speed of the four runs on the measured mile was 14·2 knots per hour. The runs, so far as the present trials are concerned, were completed next day when the ship made an hour's steaming with the expansion valves set at the earliest cut-off—that is, at 1-9th of the stroke. The engines made sixty-one revolutions, the power developed being 5680 horses, and the speed realised 12·8 knots per hour. Diagrams were taken of the other grades of expansion. The engines were stopped in 17 sec., started to full steam ahead in 7 sec., and reversed in 15 sec. The *Neptune* was purchased from the Brazilian Government, and is better known as the *Independencia*. Since her transfer a considerable sum has been expended in superseding her Whitworth guns with service pattern ordnance, the distinctive rifling of Sir Joseph's steel guns requiring special projectiles, the providing of which at the various ports at which she might call for fresh supplies would involve extra expense and additional labour. Her four 35-ton guns in the turrets have been replaced by 38-ton weapons, and her two 9-ton guns under under the forecastle have given place to twelve half-tonners. These alterations have required enlargements of both the bow and turret ports. She has also been supplied with torpedo and electric light gear and a Nordenfelt equipment, and been fitted out as a flag-ship, while her rig has been modified to prevent her being over-sparred, and precautionary measures have been taken in the engine and boiler rooms to afford protection to the ship in the event of these spaces being flooded.

Francisco Reyes. — Last week the new steamer *Francisco Reyes*, built by Messrs. A. and J. Inglis, Pointhouse, Patrick, to the order of Messrs. Ker, Bolton and Co., Glasgow, for foreign owners, proceeded down the Channel on Tuesday on a trial trip. The new vessel is constructed with a double bottom on the bracket circular system, and its chief dimensions are as follows:—Length, 195 feet; breadth, 27 feet; depth, 18 feet 8 inches; tonnage, 800 tons. On the measured mile the vessel attained a speed of 11 knots an hour, and the working of the machinery was very satisfactory.

Titantia.—The s.s. *Titania*, which has recently been built by Messrs. Raylton, Dixon and Co., for Messrs. C. T. Bowring and Co., of Liverpool left the builders' yard on Friday morning last to make her trial trip, on her first voyage, thence to Dundee. This vessel, which has been specially built above Lloyd's requirements for the Altantic trade, is:—278 feet length over all, by 35 feet 3 inches beam by 24 feet 6 inches depth of hold; she is built on the three-decked principle, her main and upper decks of iron, the latter being sheathed with wood. She is strongly fitted with shifting boards, dividing her holds into several compartments for grain-carrying in bulk, has water ballast in engine and after hold, and in a large chamber in her fore hold, which can at will be used as carrying space. The accommodation for captain and officers is amidships under the bridge, which is strongly protected with watertight bulkhead at the fore and after ends; she has steam steering gear on the bridge, screw-steering gear aft, the latter being protected by a short poop or hood. The gross register is about 2000 tons, and she will carry 2780 tons on 22 feet draught of water. Her engines of 170 horse-power, fitted with all the latest improvements, are by Messrs. Thos. Richardson and Sons, of Hartlepool; she has four steam winches, iron pole masts, and is in every way most completely fitted and adapted for the Atlantic trade. A small party of the owners and their friends accompanied Mr. Dixon and the engineers on board, when a run was made off Hartlepool as a preliminary trial of her engines, which was eminently satisfactory, and the vessel then proceeded on her voyage to Dundee, where she will fill up before making her first voyage to New York.

Naval and Marine Exhibition at Glasgow.—A largely-attended meeting of shipbuilders and engineers was held last week, at which an executive committee to superintend the forthcoming exhibition was chosen. From the promises of support and co-operation which have been already received, a confident expectation was expressed that the exhibition will prove, in point of extent and interest, quite adequate to the great industry it will represent, and in every way worthy of the predominant position of the Clyde as a shipbuilding and engineering centre.

West Hartlepool Docks. — On Monday the first vessel entered the new docks at West Hartlepool, which have been for some years in course of construction. Water having been allowed to enter, and a portion of the piles removed from the eastern coffer-dam, one of the steam barges of the North-Eastern Railway Company towed in a dredger by which the remaining preparatory work will be done before the formal opening. The opening of the immense drawbridges by hydraulic machinery constructed by Sir W. Armstrong and Co., of Newcastle, was watched with much interest.

Saving Life at Sea.—The Council of the Society of Arts have awarded the Fothergill gold medal, offered for the best means of protecting ships from loss by fire or by sinking, to Mr. Donald Currie, M.P., for the improvements he has introduced into his passenger steamers, having for their object the prevention of loss of life at sea from fire or accident, and exemplified in the ship *Grantully Castle*, of the Castle Line of packets. They further recommend that a Society of Arts silver medal be awarded to Mr. J. W. Wood for his leak-stopper. In answer to the invitation offering the prize, thirty-two applications were sent in. These were considered by a committee, which has reported on them and recommended the above rewards.

New Store Ship.—A new ship for the use of the War Department, of much larger dimensions than any of the vessels at present employed in furnishing supplies to the home stations from Woolwich, has been built at Glasgow, and is nearly ready for service. She has been named the *Stanley*, in compliment to the late Secretary of State for War, and has been designed with a special view to great carrying capacity, as she will probably be required to convey guns of the largest type to the ironclads which are to receive them in the Dockyards. Her engines, which are now being put in, are on an improved principle, and are calculated to ensure a fair speed. The ship is expected to arrive at Woolwich in July.

The Labour Market.—It was arranged on Wednesday, at Darlington, by the standing committee of the board of arbitration, that with a view to a satisfactory settlement of the wages question, a full meeting of the board of arbitration should be held to consider the sliding scale, and more particularly the method in which the average selling prices of iron were made up by Mr. Waterhouse's account to the board. The men remain at work under protest, and an inquiry of this nature is necessary to satisfy them that the reduction lately awarded by the sliding scale is correct. The 1200 colliers on strike at Talke, North Staffordshire, will soon be joined by a large body of men lately employed by the Chatterley Coal and Iron Company. The company have decided to stop its works again. It is ominous that the pits are closed for Whitsun holidays till Wednesday in next week. Already there is considerable distress through want of work in the district. The Fife and Clackmannan coalmasters refuse to comply with the request of the miners in their employment that a conference should be held between the representatives of both parties in regard to the reduction of wages announced on the 8th inst. They state that the reduction was decided upon as a necessity owing to the price of coal and pig-iron having recently heavily fallen. The council of miners of the South Staffordshire district have passed a resolution instructing the representatives on the council and of the several districts "not to give notice for the termination of the Birmingham agreement; because, whilst sincerely desiring to secure an improvement of the sliding scale, the members of the association are equally desirous not to increase trade complications by terminating exising arrangements." A memorial has been forwarded to the Premier by the Trades Union Congress Parliamentary Committee, setting forth the subjects upon which the working classes most urgently require reform. The programme includes an alteration of the law respecting employers' liability for workmen's injuries, codification of the laws administered at petty sessions, reform of the qualification of magistrates, completion of the codification of the criminal law, and reform of the jury laws. The questions of reform of the land laws, the county franchise, and the redistribution of seats are not referred to, it being understood by the committee that they form a part of the Government programme. A meeting of chainmakers was held on Wednesday, at Cradley Heath, to consider what steps should be taken with regard to the notice for an advance of wages to 4s., which expired on Saturday last. The Chairman said if a strike did not take place very soon the prices would be down as low as they were last year. The general price in the trade now was 3s. 6d. list. and the merchants at Birmingham, Wolverhampton, and eleswhere based their prices upon that rate. If there was no strike the men would soon be brought down to the 2s. 6d. list, on which also the selling price would be fixed. After considerable discussion, the question of the proposed strike was postponed until Monday. In all probability a general strike will then be declared, unless the advance is conceded by the masters in the meantime.

New Armstrong Guns.—The Select Committee on Heavy Ordnance, of which Major-General Gordon, R.A. is president, are now engaged in preparing a report of a series of trials, concluded at Shoeburyness at the end of last week, which have taken place with a view to testing the range and velocity of the new 6-inch, and 8-inch Armstrong guns, designed for siege and garrison purposes. So far as their investigations have already gone, the results have it is stated, far exceeded the most sanguine expectations. The 6-inch, with a 35 lb. battering charge, and an 80 lb. shell, attained a velocity of a fraction over 200 feet per second, while the 8-inch, with a 20 lb. battering charge and a 184 lb. shell a velocity of 2300 feet per second. With a shell of an improved pattern, the velocity was increased to 3000 feet, which is said to be far beyond that which has been previously obtained by any gun now in use in the service.

CONTENTS.

		PAGE
TAY BRIDGE DISASTER		367
OUR TRADE SUMMARY		367
HISTORY OF MODERN INVENTION	(Illust.)	367
FRENCH DISTILLING APPLIANCES	(Illust.)	370
IRON AND STEEL INSTITUTE		370
STEAM TRAVELLING CRANE		370
OCCASIONAL NOTES		370
DEPHOSPHORISATION OF IRON		371
SCIENCE AND ART		372
METALLURGY AND MINING		374
SANITARY, ENGINEERING, &C.		375
NAVAL ARCHITECTURE		375
CORRESPONDENCE		377
NOTICES OF BOOKS		377
FACTORY NOTES		377
AMERICAN GLEANINGS		378
IRON AND COAL TRADE REPORTS		378
CONTINENTAL MINING AND METALLURGY		380

OFFICIAL NOTICE.

ALL payments for Subscriptions, Advertisements and General Accounts are to be remitted to the **Office, 161, Fleet Street, E.C., London** Cheques and Post Office Orders to be made payable to PERRY F. NURSEY, and crossed "London and County Bank."

Advertisements and other Business Communications to be addressed to the PUBLISHER.

To ensure insertion, Advertisements should reach the Publisher not later than Thursday morning.

Communications on literary subjects and books for review are to be forwarded to the EDITOR. Anonymous correspondence will be wholly disregarded, and the return of rejected MSS. cannot be guaranteed.

All Subscriptions are Payable in Advance, at the ollowing rates per annum, **including postage** :—

The United Kingdom	£1	8	6
British Colonies generally and United States	1	10	0
India, China and Japan	1	15	0
South America, East Coast	1	10	0
" " West Coast	1	15	0
The Continent of Europe, Egypt and Algeria	1	10	0

Further information will be supplied on application to the PUBLISHER, 161, Fleet Street, London.

FRANCE.

MESSRS. GALIGNANI (Baudry, Jeancourt et Cie.) of 224, Rue de Rivoli, Paris, will supply thick or thin copies of IRON on application, and will receive subscriptions or advertisements.

THE UNITED STATES.

Messrs. WILLMER and ROGERS, Beekman Street, New York, will supply thick or thin paper copies of IRON on application.

CORRESPONDENCE.

SPIRAL SPRINGS.

To the Editor of IRON.

SIR,—In an article headed "Railway Springs," which appeared in IRON of the 19th March last, certain views are brought forward which we expected would have led to some discussion ere this, and which we think ought not any longer to pass unchallenged. In that article it is stated that it is impossible to get rid of friction in volute springs. We contend that in a properly made volute spring, made on the same principles as our volutes always have been, there is no friction. The conclusions in this instance were probably drawn from volutes which, through ignorance or design, have been made in such a manner as to ensure friction, so as to take advantage of the superior test as regards bearing load such volutes show; yet no one could call such a volute, where the high test is obtained solely by friction, a properly made spring, or one at all likely to give satisfactory results in continuous regular work. Where volutes properly made, and of a good quality of steel, are applied, we think they will still be found to be the best form of spring, excepting laminated springs, to withstand the rough usage of railway work. In proof of this we have records from railways where such volutes applied to wagons have been at work for years with practically no repairs or replacements. Helical springs are certainly free from friction, but are open to the objection of inaccurate coiling, leaving unequal spaces between the coils, or when the bar twists or leans out of its correct direction of square to the centre line, then the spring when pressed home is strained unequally, and when subjected to violent shocks will probably not work for any length of time. Further, such spiral springs, made with wide or half-thick bars, have their exterior surfaces very much stretched and displaced to the disturbance of the continuity of the steel.

With regard to the theory of hardening advanced in the article, our experience has been that owing to the searching influence of the oil used in cooling, a spiral spring whose coils are not quite close upon one another is practically of equal hardness over the whole area of a cross section of its bar when fractured, the grain shows perfect uniformity in size, and in resisting any impressions made upon it. Again, when being softened, which process requires watchfulness and care, the action of the heat is a gentle one, and although the exterior surface of the spring comes in contact with and absorbs more heat than does the interior, yet the raising of the temperature is so gradual as to be practically uniform. Any diversity in the heating of the unequal section spiral spring would only tend to lessen the excess of hardness the thinner exterior surface would take in the hardening process, through the greater temperature of this portion of the bar and the freer access of the cooling fluid. We find thus that any open coiled spring, whether of equal or unequal section, is, after annealing, equally hard throughout its entire area of cross section, not showing anything approaching a central core of mild or hard steel in any fractured portion. It is claimed for the unequal section spiral springs of Timmis that they are more powerful than any other spring. It is obviously against all theory that the metal in this form is utilised to the greatest advantage, and the following comparison of results given by one of our spiral springs of rectangular section with one of the Timmis' of similar weight entirely disproves that anything can be claimed by the latter on the score of greater power. It will be seen that our spiral spring weighing 3 oz. less than Timmis' stands a load of 4 tons without being driven home, whereas Timmis only gives 3 tons driven completely home according to his own diagram.

Timmis spring 15½ lb. wt., 8 inches high, 1¼ × 9-16 inches, unequal section :—

½	1	1½	2	2½	tons
⅝	⅞	1 5-16	1¾	2	inches deflection.

Spencer's spiral, wt. 15 lb. 5 oz., 1¼ × 9-16 inches rectangular steel :—

½	1	1½	2	2½	3	3½	4	tons.
⅜	⅝	1	1⅜	1 11-16	2 1-16	2 7-16	2⅝	inch deflection.

We are, yours, &c.,
JOHN SPENCER AND SONS.

Newburn Steel Works, Newcastle-on-Tyne,
14th May, 1880.

NITROGEN IN IRON AND STEEL.

To the Editor of IRON.

SIR,—In your report on the discussion of the paper on "The Presence of Nitrogen in Iron and Steel," read by me at the recent meeting of the Iron and Steel Institute, there are some inaccuracies which I shall be glad if you will allow me space to correct.

With reference to Mr. Stead's question about occluded nitrogen, Müller, of Osnabrüch, drilled holes in iron and steel, and analysed the gases which collected in the cavities from which the borings had dropped out. The nitrogen found in these gases, when calculated to percentage by weight of the iron drilled, gave an amount very similar to those found by me in a wholly different manner. Whether this is more than a coincidence I cannot say, but I am not disposed to attach much importance to the fact. My impression is that the nitrogen eliminated as ammonia by the action of steam or acids, exists in the metal as nitride of iron—not nitr*ate*, as in your report.

As to the possible association of the nitrogen in the metal with titanium, as a nitride or cyanide, Mr. Riley remarked that the so-called "titanic-plate" usually contained no trace of titanium. With reference to this, while admitting the fact as a rule, I stated that I had met with titanium in titanic-plate iron, and that, with all Mr. Riley's experience in searching for titanium, I doubted his ability to detect so small a proportion as ·01 per cent. (not 1 per cent., as in the report) of titanium, which would be a quantity comparable with the amounts of nitrogen estimated. Having now definitely established the fact of the existence of nitrogen in iron and steel, and devised a simple method for its estimation, I intend to endeavour to ascertain the mode in which it exists.

I may add, that in my remarks on the paper of Messrs. Parry and Tucker, I contended that a certain weight of hydrogen would occupy a larger volume when uncombined than if it existed partially in combination with carbon. In illustration of this fact I may give the volumes occupied by 1 gramme of hydrogen in various conditions under the same pressure and temperature.

1	gramme of hydrogen,	free,		measures	11·2	litres
1	"	as marsh-gas,	CH_4	"	5·6	"
1	"	as olefiant gas,	C_2H_4	"	5·6	"
1	"	as benzol vapour	C_6H_6	"	3·73	"

Hence, in combination with carbon, the hydrogen measures less than in a free state, not more, as I am reported to have argued.

With respect to the freedom of the sulphuric acid from traces of ammonia, Mr. Tucker informed me privately that he and Mr. Parry had found the impurity very difficult to remove, but that they had assured themselves of its absence before employing the acid.—I am, &c.,

Sheffield, May 15th, 1880. ALFRED H. ALLEN.

NOTICES OF BOOKS.

Pocket Mining Atlas. By EDWIN BOLITHO. New York: *Engineering and Mining Journal.* 1880.

THIS is a bijou affair, about five inches by three, containing a map of the United States and twenty-five other maps and plans of mineral districts and mines in that country. It is claimed for these maps and plans that, making allowance for inevitable errors from the constant addition of new mines and frequent changing of locations, their accuracy may be relied upon. They are clearly printed and distinctly coloured, and will be useful to the numerous class which has invested in transatlantic mining shares.

Minutes of Proceedings of Institute of Civil Engineers, with Other Selected and Abstracted Papers. Vol. lix. London: Published by the Institution. 1880.

THIS volume of transactions covers the period from the 11th of November to the 23rd of December, 1879, and besides the usual business records, contains reprints of the more important papers read at the meetings, abstracts of the less weighty ones, and reports of the discussions upon them. As we have already published in our reports of the meetings of the Institute, both papers and discussions more or less fully, there is no need to refer farther to them here; but we cannot omit to notice the highly creditable manner in which this volume has been produced, as regards paper, printing and illustrations, as well as several improvements in detail upon the preceding ones, such as the page headings and the sidenotes of speaker's names, which are convenient helps in its perusal. The promptitude with which it has been issued is also noteworthy; and it is announced that three other volumes will be published at intervals of about two months.

The Origin, Properties and Uses of Natural Lubricating Oils. By J. VEITCH WILSON. Glasgow. 1879.

THIS is a series of three tractates on a subject of vital importance to all users of machinery. They are issued by a well-known firm in the lubricating oil trade, in the first instance, no doubt, for the advice and guidance of its own customers, but they are at the same time of more general interest and use. The first of the series supplies a general account of the mineral oils employed in lubrication, and a clear analysis of the essential requisites of such oils, with regard to freedom from tendency to gum, liquidity at or under the freezing point of water, and the possession of high boiling and firing points; the second, in addition to this, specifies the properties suitable to the various classes of machinery: and the third is devoted mainly to a discussion of the latter considerations, with a list appended of the special lubricants prepared by the firm.

The Resources of Queensland. By JAMES BONWICK, F.R.G.S. London: S. W. Silver and Co. 1880.

WE have here a skilfully condensed account of the youngest of our Australian colonies and not the least interesting, written in a style which compares favourably with that of the ordinary guidebook, spirited without degenerating into bombast, full of such information as an intending emigrant seeks, and at the same time containing much calculated to attract the attention of an intelligent reader who has no thought of leaving home. The geology of the colony is first described as having an all-important bearing upon its capabilities, which are very varied, the climate ranging from warm temperate to tropical, and suited, according to latitude and altitude, for the cultivation of the European cereals, for pastoral industry, or for the usual tropical crops, including the cotton plant and the sugar cane. Queensland possesses also great wealth of timber, both for building and ornamental purposes. Her mineral resources comprise coal, iron, tin, copper, gold and precious stones. The deposits of coal in the colony are of enormous extent and of the best quality. Neither their extent nor value has, however, been accurately ascertained; but the author gives a full account of both as far as surveys have gone. In one field, we notice, there are five workable seams of good coal and eight smaller ones in 1000 vertical feet. The Mackenzie area in the north is estimated by Mr. Clarke to occupy 40,000 square miles. Another field covers six degrees of latitude. Iron ores abound everywhere. On the Brisbane River is one of the largest deposits of chrome iron in the world; hematite deposits are frequent. Both copper and tin have been worked to a considerable extent; but the industry has been checked by the state of the markets. The yield of gold in 1877 reached £1,611,103 in value, and 1879 is calculated to show much better returns.

NEW BOOKS.

Celestial Scenery. By Dr. T. Dick. New Edition. Crown 8vo. Griffin.
Farming and Railroad Interests in America. By J. Harold. 8vo. Cassell.
Hertslet's Commercial Treaties. Vol. 14. 8vo. Butterworth.
Lectures on Art, delivered at the Royal Academy. By H. Weekes. 8vo. Bickery.
Manual for the Physiological Laboratory. By V. Harris and D. Power. Crown 8vo. Baillière.
Manual of the Alkali Trade, including the Manufacture of Sulphuric Acid, &c. By J. Lomas. Royal 8vo. Lockwood and Co.
Outlines of Geology and Geological Notes of Ireland. By W. Hughes. New Edition. Crown 8vo. Simpkin and Co.
South Kensington Art Hand-Books; Persian Art. By Major Smith. Second Edition. 8vo. Chapman and Hall.
Treatise (A) in Plane Co-ordinate Geometry. By J. Todhunter. Sixth Edition. Crown 8vo. Macmillan and Co.
Typographic Printing Machines and Machine Printing. By F. J. Wilson. 8vo. Wyman.

BOOKS RECEIVED.

A Course of Qualitative Chemical Analysis. By the late W. G. Valentin, F.C.S. Revised and Corrected by W. R. Hodgkinson, Ph. D. Fifth Edition. London: J. and A. Churchill.
Bicycles and Tricycles of the Year. By H. H. Griffin. London: *Bazaar* Office.
A Manual of the Alkali Trade, including the Manufacture of Sulphuric Acid, Sulphate of Soda, &c., with 232 illustrations. By John Lomas. London: Crosby, Lockwood and Co.
The Great Artists—Michael Angelo. By C. Clement. London: Sampson Low and Co.

FACTORY NOTES.

THE Millom Iron Smelting Company have blown out one of their six furnaces for repairs.

SYDNEY INTERNATIONAL EXHIBITION.—Messrs. William Allday and Sons of Birmingham have been awarded three prizes at this exhibition, a first prize for their bellows, forges, smiths' tools, &c., another first for fancy bellows, and a second for anvils and vices.

THE ANTI-CORRODO PROCESS.—We are pleased to learn that the Rustless and General Iron Company of 97, Cannon Street, London, have been awarded a gold medal at the Sydney Exhibition for their Anti-corrodo tubes and fittings treated by Professor Barff's rustless process. We understand that tubes thus treated are coming largely into general use especially for gas and water purposes.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending 15th May:—On Monday, Tuesday and

Saturday (free), from 10 a.m. to 10 p.m., Museum, 11,426 Mercantile Marine, Building Materials, and other Collections, 1758. On Wednesday, Thursday and Friday (admission 6d.) from 10 a.m. till 6 p.m., Museum, 2882; Mercantile Marine, Building Materials, and other Collections, 69; Total, 16,135. Average of corresponding week in former years, 14,242. Total from the opening of the Museum, 18,929,297.

Disastrous Boiler Explosion.—At the Birchills Iron Company's works, at Walsall, on Saturday, a boiler exploded with terrific force, causing the death of twenty-five persons, and injuries of a more or less serious character to upwards of sixty others. Several of the wounded are in a very critical state. The greatest excitement prevailed in the district. The boiler which exploded was new about thirteen years ago, and had been carefully kept ever since. Since November, 1877, it had been inspected by the Boiler Insurance Steam Power Company (Limited), Manchester, with which company, at their own request, it was re-insured last week. The pecuniary loss will, therefore, it is stated fall upon that company. Previous to the inquest the coroner and his jury visited the works and made a minute inspection of the fragments of the boiler, which were found to be corroded and thin in parts. The inquiry was adjourned till to-day, when the evidence of Mr. Marten, of Stourbridge, will be taken at the instance of the coroner, and the evidence of one or more experts at the instance of the town authorities. A meeting has been held to consider the best means to relieve the suffering caused by the boiler explosion. It was stated that over 150 persons have claims, including twenty-one injured men, few of whom will ever be able to work again; £12,000 will be required. Another meeting is called for to-night, at which the borough member will be present, to consider the subject.

AMERICAN GLEANINGS.

Light Locomotive.—An American firm have completed a locomotive which is said to be the lightest ever made for actual service. The cylinders are but 6 inches in diameter. It is to haul gold and silver ore, on a 20-inch track, from the mines of Friendenstraw and Co., of Arizona. Its capacity on a level track is 150 tons.

New Cattle Car.—A St. Louis man has patented a new cattle car. The peculiarities of the invention consists in placing the stock in four racks lengthwise the car. The racks in each end of the car stand facing each other, and a combination water-tank, trough, and hay-box extends crosswise the car under the heads of the cattle. Chains or belting fastened to the floor pass up between the stocks and are attached to a shaft overhead, which, being turned, draws them tight, and holds each animal in place. Water and feed is carried for a trip of four days, and stock can eat, drink, lie down, and rest without the train stopping. Reversing the shaft the stays fall off and drop down. The water-tank is on a roller, and can be easily moved to the end of the car. The car is then ready for any kind of freight.

The Corliss Engine at the Philadelphia Exhibition.—The Chicago *Tribune* states that in the engine room of the new Pullman Car Works, now being erected at Kensington, Chicago, will be placed the beautiful Corliss engine, which was one of the wonders of the Centennial Exhibition, where it drove eleven acres of machinery. This great engine will furnish all the power needed by the Pullman and Allen works. Its original cost was $114,000. It was nominally 1400 horse-power, but it can be run up to 2500 horse-power. Its size may be inferred from the fact that a train of thirty-five freight cars will be needed to transport it from Providence to Chicago. The engine room where this useful monster will take his daily exercise is so situated that its thirty-five foot fly-wheel will be in full view from the railroad or the park around the works. Its front will be of plate glass, with iron columns, so that its motion may be as plainly seen as that of a watch in a glass case. The engine and boiler cost $125,000, and the machinery, exclusive of power, pulleys and shaftings, cost $100,000. A large part of the Pullman machinery, which will be all new, as the Detroit works will run along as usual, has already been made. All the buildings will illuminated with the electric light, and heated with steam. There will be 7,827,026 cubic feet to be warmed, and to do it will require 230,536 feet of steam pipe.

IRON AND COAL TRADE REPORTS.

BARNSLEY AND SOUTH YORKSHIRE.—There are but very few encouraging features to notice in connection with the coal trade of this important district. The state of the trade was never worse, and present indications are decidedly adverse to any improvement. So quiet is the state of affairs that most of the more important collieries which set down on Saturday for the Whitsuntide holidays will not resume operations until Friday morning. Another instance, if one was required, might be noted in the fact that the Manchester, Sheffield and Lincolnshire Railway Company, which collects and carries the coal to Doncaster for the Great Northern, were able to dispense with twenty-four goods and coal trains in the South Yorkshire district for several days during the holidays. Business with London is remarkably quiet, and the tonnage by rail is consequently much less than it ought to be at this period of the year. This, the coalowners contend, is in a great measure due to the heavy tonnage rate imposed by the Midland and Great Northern Companies. The demand for the Eastern counties is only moderate, notwithstanding the low prices at which both Silkstones and Barnsley thick coal is sold. The latter can be purchased at 6s., and Silkstones at 7s. 6d. per ton at the pits. In steam-coal a slight improvement is noted, and where a good quantity is raised a fair demand is being had for Hull and Grimsby, where most of the coal is exported for the Baltic and other ports. In locomotive coal a tolerable business is passing, but several important contracts are drawing to a close. Amongst others the Midland and Great Eastern contracts are about being renewed, and as the district coalowners are largely interested in them, considerable interest is being experienced. It is said higher prices will be asked, but it is to be feared that these will not be maintained, owing to the quiet state of trade. Since our last notice, the result of the Nottingham Gas Company's contract for the supply of 100,000 tons of "soft coal and soft cobbles or nuts" has been made known, and has resulted in some of the old contractors being unsuccessful. A good part of the contract was supplied by the district coalowners last year, but it is stated that the only local firm which has been successful is Messrs. Newton, Chambers and Co., who managed to get 40,000 tons of it. Colliery firms which last year were successful, have tendered at the same prices and been unsuccessful. There is but little change to note with respect to the business doing in engine fuel and small coal, the demand during the week having been remarkably quiet, owing to the stoppage of the works. The coke trade is still good, and a large and increasing output is being made weekly. The number of ovens in the course of erection is very large, so that in a short time the production will be greatly augmented. A good deal of what is made is being sent to North Lincolnshire for the use of the furnaces there. The district is in a very bad state, and miners are earning extremely scanty wages. Some idea may be formed of the position of affairs when it is stated that a local colliery firm last week advertised for a storekeeper at 25s. per week, and in a day and a half they received 145 written, in addition to many verbal applications. In connection with the state of trade, attention is being called to the fact that the splendid South Kirkby Colliery belonging to the Rosedale and Ferrybridge Iron Company, on which nearly £77,000 was expended, is still unsold, although it is understood that a very moderate sum would secure it. There is but little new to note in connection with the iron trade. Business since our last notice has been so limited that there has been but few opportunities for noting changes. The foundries are doing but a quiet trade, as are also fitters, moulders and engineers. No falling off is observable at the Bessemer steel works, and the furnaces engaged in the make of pig-iron are kept fully going.

BARROW-IN-FURNESS AND NORTH LANCASHIRE.—The holiday season has tended to bring about a much quieter tone, in the iron market of this district this week. Very little business is being done by makers, although they still have their works very fully employed, and it is highly probable that there will be continued activity throughout the season so far as the industries of the district are concerned, but it seems equally probable that in the meantime the orders on the makers' books will not be considerably increased. On home account there is a quiet demand for iron, and, although prices are gradually declining, buyers do not show any disposition to increase the extent of their orders. On the other hand, there is a belief generally entertained that the request for Bessemer qualities of iron especially, will revive before the orders in hand are disposed of, and before there is any necessity for blowing out some of the furnaces now in blast. The forge iron is also likely to be received with more favour, so soon as the development of the Siemens-Martin steel-making process is further advanced in the district, and of which there are better indications every day. It is impossible to give any reliable quotations as to the value of hematite pig-iron, as only a small business has lately been done. Shipbuilders have on hand a good number of orders and their works are briskly employed, although there is room for further orders, and as the demand for iron-marine has lately improved there is every prospect of the orders in hand being further augmented. The demand for iron ore is fairly maintained, but it is far from being active. Prices are steady at from 15s. to 18s. per ton, but large deliveries have to be made at the full prices which ruled in February, 30s. and 35s. per ton. The coal and coke trade is steady, and there is a large consumption. Shipping is very brisk.

BIRMINGHAM.—Manufacturing operations have been suspended for two or three days during the past week in consequence of the Whitsuntide holidays, and business generally has also been seriously interfered with. The downward tendency of the metal markets has continued to prejudicially influence the demand for steel hardwares, particularly in the heavier branches. Orders both on home and foreign account have been very scarce. The Australian trade remains dull, except that a moderate request for steam-engines and machinery has recently been experienced, but some recent advices speak hopefully as to the prospects of a very satisfactory fall trade. At present the principal markets, both in Australia and New Zealand, are somewhat overstocked, and there is apparently no inclination on the part of colonial buyers to concede the higher prices asked for goods on this side. A brisk demand has recently been reported alike from the United States and on Continental account for railway material, and a fair supply of orders has also come to hand from India, the Cape and Italy for railway carriage ironwork and fittings, and for locomotive tubes. A few of the leading manufacturers of edge-tools have been busily engaged upon orders for axes and picks for the Cape, the West Indies and South America, and manufacturers of gas-tubing have also had good contracts in hand for the last two markets. Large quantities of the very commonest makes of metallic bedsteads have recently been shipped for the Continent and the colonies, and the demand for this special make of goods still continues; but the export trade in the better qualities is singularly inactive, so that, taken all round, this department of local industry is far from being in a satisfactory condition. The customary demand for plated goods from the north of Europe is slack, but the competitive articles turned out by manufacturers of different nickel alloys are going off well, orders being chiefly from Canada, South America and the Cape. In nearly all branches trade on home account is reported as remarkably quiet, the districts in which the depression is less seriously felt being Lancashire and Scotland. Business with the metropolis and the southern districts is quite stagnant. There is some little improvement in the demand for travelling trunks and toilet ware, and a few of the best firms in the metallic bedstead trade have been fairly busy in brass goods of superior quality and finish. An increasing request has been experienced for electro-plated spoons and forks, but the activity is limited to these special classes of goods, and in the general bulk of fancy and ornamental articles little business is at present doing. There is a relapse in the wood-screw trade, but prices hold firm, makers having old contracts on hand which will keep them employed for some time. Prices of hardwares generally are slightly in buyers' favour, owing to the tendency of the metal markets. The associated masters have increased discounts on frying pans by 2½ per cent., making them 67½ per cent., rim and mortise lock makers, and currycomb manufacturers at Willenhall have given up the 10 per cent. advance declared some time since, galvanised buckets are reduced 3d. per dozen, and shoe-heels are reduced 10 per cent. throughout. Some indication of an approaching revival in the local iron trade, in consequence of the renewal of activity in the United States demand, have recently presented themselves, new American orders for hoop and strip having come to hand. Some good specifications for galvanised sheets have also been received in the district by the last South American mail, and a good demand for this class of goods is being experienced from the Indian and South African markets. A fair amount of rod-iron for fencing has recently been on order for Australia; but there is little else of importance doing with this market. The shipping trade, with the exceptions mentioned, has been dull. Just before the holidays there was a stimulated demand for angle, strip and sheet iron to meet the requirements of local manufacturers; but, generally speaking, the home trade remains dull, and prices are weak. The market for pig-iron is still depressed, and there has been a movement towards curtailing the production, four furnaces having been blown out in the course of this month. A report is current that the ironstone mines of the Chatterly Iron Company, only recently re-opened, are again to be closed. On Wolverhampton Exchange on Wednesday there was a very thin attendance, and scarcely anything doing. The production of pig-iron continues in process of curtailment, and Messrs. A. Hickman and Sons have blown out one of their Spring Vale furnaces. Prices were nominally weaker on the market. Collieries were reported slack of work.

Thursday Evening.—A few mills and works have restarted after the holidays, but the majority will remain closed till Monday or Tuesday in next week. Orders are scarce, and the market has been prejudicially affected by offers of agents to transfer stocks held in excess of requirements. Galvanised sheets in good request for India and South America; plain sheets in better demand, and also boiler plates. Trade generally still languid, and prices, though nominally unchanged, are practically falling from week to week. Marked bars ostensibly £9, but can be bought for less. The probability of an early reduction in the price of marked iron was freely discussed to-day. Much will depend upon the price of ironmaking coal, in which a further early reduction may be anticipated, as underselling is on the increase, and stocks are accumulating. In pig-iron the only activity apparent is speculative and confined to the commonest class of cinder-pig, which is changing hands at about £2. The number of furnaces in blast is reduced to fifty-six.

CARDIFF.—There is no marked alteration in the position of the iron trade since our last report, but the reverse that has overtaken it is unpleasantly affecting both makers and ore dealers. In spite of signed contracts, some consumers are making difficulties about receiving iron invoiced at prices no longer current, and this unmercantile treatment is in some cases passed on by the iron maker to the ore merchant. At Blaenavon two of the furnaces remain unlighted, and the celebrated cold-blast pig of this brand is no longer made. After having a very good time, the tin-plate industry has again got sick, and the men have been scheming to cure it by a diminished output. A little common-sense co-operation between masters and men and absence of treachery among the former, would, without doubt, have a salutary effuct. Meantime the alternative, but futile remedy, of a reduction of wages is talked of. The future of the iron and steel trade is much debated, and it seems to be forgotten that an unreasoning depression is quite as common a feature in manufacturing markets as an unwarranted inflation. The pure and simple results of uninfluenced supply and demand are nowhere and at no time to be found. Iron and steel took the lead in the present undoubted revival of trade, and cannot be left behind in the general progress. The position of the coal trade is peculiar, a larger export than ever is taking place this spring; but prices do not tend upwards. The amount of trade doing may be judged of from the fact that more than one firm of colliery proprietors and coal exporters ship over a million tons each in the course of a year. Any colliers wanting work can have it in the Aberdare and Rhoudda Valleys. Some firms have considerable difficulty just now in getting on with their coaling, as the holidays have still further diminished the get; but, as already said, the aggregate output is larger than ever. Coke is still selling at the ovens at 15s. The demand at Liverpool and London continues to improve; that from France remains quiet. Italy is taking largely.

CLEVELAND.—Being Whit Tuesday there was but a meagre attendance on 'Change, and little or no business was done. Prices which had considerably fallen since the previous market day were rather steadier, and showed a tendency to become slightly firmer. The ruling quotation was 37s., but 36s. 6d. and 36s. 9d. were taken for small lots. The weather being so fine the general holiday seems to have been prolonged, but the works are being started successively so that the industry of the district will soon be once more in full swing. The finished-iron trade is doing tolerably well, but with no great prospect ahead. The ironfounders are doing rather better than they were, and the engineers also. The successors of the firm which built the Tay Bridge have been favoured with a large Indian order for bridgework, so that the ordeal to which Mr. Kirkcaldy submited the iron of the bridge seems to have vindicated the reputation of Cleveland wrought iron. Ship plates £6 15s. to £7, common bars £6, both less 2½ per cent. delivered on trucks at works. The coal trade is rather dull, except perhaps steam-coal and coke, as before.

DERBYSHIRE.—The past week has been an extremely quiet one so far as trade is concerned, the Whitsuntide holidays being the all-absorbing theme pursued. The works devoted to the manufacture of finished iron have been to a great extent closed and it is to be regretted that a rather quiet tone is observed particularly with regard to the foundries. There is a fair business doing in heavy castings and the whole of the furnaces in the district are in full blast, and have not been influenced by the stoppage of the other works. The two furnaces at Wingfield belonging to the Dodworth and Silkstone Iron and Coal Company (Limited) have been almost throughly repaired and are expected to be put into blast shortly. The coal trade is much quieter than it was a short time ago, in fact in some parts of the district a marked depression has come over the scene. The pits working the black shale coal are only employed about half time. The demand for London is more limited than it was, the Midland having carried a much less tonnage last month than it did a short time before. Some of the leading pits have some good contracts on hand and despite the quiet state of trade, ten of them managed to forward 112,000 to the metropolis by rail. The Land Sale pits are doing a fair business in house-coal more particularly those nearer the Nottingham district. A somewhat singular verification of the proverb of "Sending coals to Newcastle" is said to have occurred here—an enterprising firm of London coal merchants advertising their prices for coal delivery in Chesterfield. The Temple Normanton Colliery Company are delivering their best brights at 11s.; best hard at 10s.; and seconds at 8s. 9d. and 8s. 6d. per ton in Chesterfield whilst the Boythorpe Company quote best Silkstones at 9s. 10d.; best Tupton, 8s. 1d.; screened cobbles 4s. 10d.; and screened nuts 5s. 10d. per ton. There is a good demand for gas-coal which seems likely to be sustained, seeing that some of the collieries have secured a fair share of some of the contracts for supplying gas-coal which were supplied by district collieries. There is a fair enquiry for small coal and slack for manufacturing purposes, but prices continue low. The coke trade is pretty good and where a good smelting coke is produced, a fair sale is being had. Some of the seams, however, do not make such a good out-turn as the market demands, but improvements are being constantly introduced with a view of remedying this defect.

DURHAM.—The iron trade has been dull throughout the week. At the same time the prices of pig-iron have been moderately steady. Most of the sellers ask 37s. No. 3, and 6d. more for forge pig, whilst it is stated that two furnaces are to be blown out at Witton Park, belonging to Bolckow, Vaughan and Co.; two others are being blown in this week at the Middleton ironworks, so that the number of furnaces brought into blast in this county by the more active state of trade will not be decreased—at least, for the present. It cannot, however, be expected, if the prices of pig-iron keep down to their present low ebb, that furnaces farthest away from the seabord and from the deposits of ironstone will be kept going for any lengthened period, as they must unquestionably lose money. A bad state of trade and low prices will therefore probably have the effect, should such conditions permanently appear, of reducing the number of furnaces in blast in this county, and concentrating the pig-iron trade more in the district of Cleveland proper. The manufactured iron trade has remained at a low ebb. Prices have not materially altered, but the tendency is certainly in a downward rather than in an upward direction. The prices for angle-iron are about £5 17s. 6d. to £6; bars, about £6; iron rails, £6 2s. 6d. to £6 5s.; ship-plates, £6 15s less 2½ per cent. Puddled bars about £4 net. The difficulty at the present time is get orders. Work is being fast disposed of, and manufacturers who were hoping that by this time more orders would have come to hand, are grievously disappointed. The iron rail trade is especially dull. Some of the larger plate manufacturers are reported to have orders in for a considerable time, but in other instances work is running short in this department, the same as it is with the majority of the iron rail and bar producers. The engineering works, though fairly brisk, are not finding men work very plentifully. The coal trade has been getting dull in sympathy with the iron trade. Manufacturing coals are offered now at lower rates, and there is very little difference between the present prices, if any, and those which ruled before the advent of improved trade last year. Manufacturers of coke are offering at much lower rates for all but the very best qualities.

FOREST OF DEAN.—The Whitsuntide holiday has been associated with charming weather. Had the times been at all in keeping therewith, the festival might have been a cheery one. The holiday extended only till Tuesday morning, when work was resumed at the pits, and the majority of colliers, to whom was afforded the opportunity, embraced it. Recently the coal trade of Cinderford Valley has shown signs of improvement, and at some of the pits no loss of time has arisen. Unfortunately for the proprietors they are subject to as keen competition as ever, and the advantages afforded to their opponents by giving exceedingly cheap long rates minimises any advantages Forest proprietors may reasonably expect to command in regard to holding more approximate markets to their own districts. A case in point may be mentioned in which the local railway rate for a short distance of three miles is demanded, viz., tenpence per ton manufacturing coals, which have to be delivered at 5s. per ton. Forest proprietors are, moreover, pressed heavily under the excessive rating burdens which, in times of low prices, pinch very sharply. The crown are the proprietors of the surface, on which they grow valuable timber, and they hold a fifth right in the minerals; and, notwithstanding drawing large revenues, are exempt from the local rating, paying only one-twenty-fifth. Several of the Forest works are paying at the rate of a thousand a year to the local rates, which appears to be unreasonable in times like the present. It is generally believed that the Crown must act more liberally in the Forest if any degree to an approach to prosperity is contemplated. These are matters productive of much irritation just now in the Forest of Dean. The iron trade has undergone no recent change, hence stocks are still heavy, but there is an apparent indisposition to press for sales. It was stated a day or two ago, on good authority, that in the month of January a Forest firm of ironmakers declined to book a 2000-ton order for their best pig at a lesser sum than £7 7s.—absolutely refusing the even money. This only serves to show the strong feeling which then prevailed that the maximum had not been reached. There is no abatement in hope that still the iron trade will soon make another move, and that then the improvement will be more genuine than was the case last autumn, when the speculators manipulated prices. Quotations for Forest pig are now rather uncertain. The tin-plate industry shows a remarkable vitality, and notwithstanding that stocks are increasing the mills are in full swing. It is understood that no difficulty will be offered by the Forest tin-plate hands in regard to the recent decision in Wales to abandon their resolution in the matter of restricting the output from 30 to 24 boxes per day. There is still a falling off in the demand for local iron ores.

GLASGOW.—The warrant market has been dull and depressed during the past week, and though prices have been somewhat steadily maintained, the tendency seems still to be downwards, as there are no immediate prospects of a demand springing up in any part of the world sufficient to take away the present excessive production. The ironmasters, instead of blowing-out furnaces, are aiming at producing cheaply; and at a meeting held to-day agreed to declare a further reduction of 6d. per day in wages, and it is not believed that there will be much if any resistence to this. The outsde public are still investing in warrants, but those in the trade are willing to supply their wants. On Thursday 45s. 10½d. to 46s. 4½d. cast, and 46s. to 46s. 6d. a month were paid, rising next day from 46s. 1½d. to 46s. 6d. cash. On Monday 46s. 5d. to 46s. cash was accepted. On Tuesday 46s. to 46s. 3d. was paid, and on Wednesday a good business was done from 46s. 3d. to 45s. 9d. cast, and 46s. 4½d. to 45s. 10¼d. a month, closing buyers 45s. 9d. cast and 45s. 10½d. a month, sellers 1½d. per ton more. The makers are selling very little and several brands have been reduced in price. There are now as many as 113 furnaces in blast against 87 at this time last year. The shipments of pig-iron from Scotland last week were—Foreign 8802 tons; coastwise, 4321 tons; total 13,123 tons against 9919 tons in the corresponding period of last year. The imports of Middlesborough pig-iron into Grangemouth last week were 3830 tons against 3220 tons in the similar period of last year. The total imports till May 15th, 1880, are 84,930 tons against 88,087 tons till May 17th, 1879, showing a decrease for this year of 3157 tons. Iron is again going into Connal's store, the stock now amounts to 442,622 tons an increase since last week of 1704 tons. The malleable iron manufacturers are badly off for orders, more especially for the smaller sizes of bars and angles. Low prices are being taken to secure contracts, but buyers are inclined to keep back their orders in the expectation of still lower prices being touched shortly. The exports last week were large, the chief items being for the East, cast iron goods valued at £15,028, machinery at £9101, wrought iron at £2096; for Australasia cast-iron goods at £10,742, galvanised iron at £3930, wrought iron at £1318, machinery at £2713; and for the Continent manufactured iron at £6619, and machinery at £859. The shipbuilders and engineers are in the meantime fairly well employed, but they are not getting many enquiries for new work. The forges are busy but founders are quiet. The steel works are well supplied with orders, but are now quoting considerably reduced prices. The coal trade is inanimate—the fine weather has lessened the demand for house-coals; shipping are not much enquired for.

LANCASHIRE.—Business generally in the immediate neighbourhood of Manchester is practically suspended during the Whitsuntide holidays, and during the past week there has been very little doing in either the iron or the coal trades of this district. There was only a very small attendance at the Manchester weekly meeting on Tuesday, and there was little or nothing doing which would really test the market. The low point now touched by prices is, however, stimulating some little enquiry from consumers, but at present there is an absense of any natural buying. Lancashire makers of pig-iron are still asking 52s. 6d. per ton, less 2½ per cent., for both foundry and forge qualities delivered into the Manchester district, but they are selling little or nothing and there is not much doubt good orders might be placed at a lower figure. Outside brands of iron are still being offered in this district by second-holders at very low figures. For Lincolnshire and Derbyshire irons, the nominal quotations of some of the makers are still about 55s. to 56s per ton, less 2½ for delivery into the Manchester district, but there is plenty of iron to be bought at about 50s. to 52s. per ton. In Middlesborough iron merchants are offering G.M.B.'s at about 45s. 10d. per ton for delivery equal to Manchester, whilst makers as a rule are asking 1s. to 2s. per ton above this figure. Hematites are still pressed for sale here at very low figures, good brands being offered delivered equal to Manchester at very little over 70s. per ton. In the finishsd-iron trade there is no material change since last week. Not only are very few orders being given out, but makers still complain that in many cases where iron was sold at the recent high prices they are unable to get specifications from the buyers, and works which might still be kept well employed if the orders on the books could only be executed are getting slack. Very low prices are now ruling in the market for nearly all descriptions of finished-iron. Bars delivered in the Manchester district are offered at about £6 17s. 6d. to £7 per ton; hoops at about £8 8s.; puddled bars can be bought at £4 per ton and under. Advantage has been taken of the strike in the cotton trade at Blackburn to get repairs done at the mills, and this has made the engineers in the above district temporarily very busy, but generally founders, engineers and machinists throughout Lancashire are still but indifferently supplied with work. In the coal trade both house-fire and steam coals are working off very slowly, and a good deal of the latter description is being thrown upon the market, owing to the absence of demand for shipment. The gas coal enquiries are being made for deliveries over the next two years, and tenders for this period are being sent in at very low figures. For engine classes of fuel there is still a tolerably good demand for both burgy and slack are easier to buy than they were. Prices, as a rule, are weak, although there is no material change to notice in quotations, which at the pit mouth may be given as under: Best coal, 7s. 6d. to 8s.; seconds, 6s. to 6s. 6d.; common round coal, 5s. to 5s. 6d.; good burgy about 4s., and good slack about 3s. 6d. per ton. The lessened consumption of coke for iron-making purposes is causing this description of fuel to become generally plentiful, and the quoted prices at the ovens are about 10s. to 3s. per ton, according to quality.

LEEDS AND WEST YORKSIRE.—The forges re-opened on Wednesday morning after the Whitsuntide holidays, and nearly, if not quite, the full resources were brought into active operation. It is impossible to say whether in every case there will for any great length of time continue to be such full work, but assuredly such will be the case with some of the largest ironworks. During last week some fresh orders for railway work came in, and besides cranks and tires, axles are being made on an unusually extensive scale. The quietest branches just now are boiler plates and merchant iron, but there is reason to believe that consumers have some good orders to give out in these two branches. Generally speaking, the prospects of the best Yorkshire iron manufacture are better than they have been at any time since the revival began to be so confidently talked about, and there is no question whatever that the work now in progress and which has already been done has gone right away into consumption, and that without adding in the least to stock the output at every forge has been tenfold what it was twelve months ago. The firms who are famous for the production of textile machinery are becoming busier almost every day. There is also more actually doing by, and a much brighter out-look for, the makers of steam ploughs and modern farming tackle. It will require, however, a much larger accession of good fortune before there is full employment in connection with those businesses which will bear comparison with the animation and prosperity of a few years back. Tool-makers are steadily rather than briskly employed. The West Yorkshire coal trade seems to be incurably dull. The pitmen have to continually deplore that they never get more thsn half a week's work, and they anticipate but little improvement of their circumstances from the operation of the new wages sliding scale, for the adoption of which accountants are now making the necessary inquiries.

LONDON.—The metal market remains in an unsatisfactory position, as every one is disappointed and contends that its statistical position ought to insure much higher prices. In iron, quietness has prevailed, pigs have ranged between 45s. 6d. and 46s. 1½d. for warrants, Copper: a good deal has changed hands in Chili bars. Tin has sustained a still further drop owing to forced sales. Lead, dull with, but little inquiry.

NEWCASTLE AND THE TYNE DISTRICT.—Business here is generally dull, and in the past few days it has been of a holiday character. The shipments of pig-iron have been large, but prices are flat. The present price of No. 3 pig here is 36s. 6d. per ton, and No. 4 forge a trifle higher; but large orders could be placed at 3d. per ton less money for immediate delivery. Ironfounders in the district are pretty well employed, and so also are the manufactured iron works. Bars are quoted £7 10s. per ton by makers, but they can be bought second-hand for much less. Ship-plates bring £7 to £7 5s. per ton. The heavy reductions of the past few weeks in the prices of this class of iron are stimulating further the already fairly prosperous condition of the iron shipbuilding trade. Steam shipowners with loose capital are taking advantage of the lower prices to speculate in new vessels; and altogether the prospects for the summer are at the least encouraging. There are rumours that some sections of the men engaged in the ironwork of our shipyards are meditating a demand for an increase of wages, but there is no immediate fear of any unpleasantness between employers and employed, as there is reason to believe the latter will be satisfied with concessions similar to those granted at other building ports, and these are not large. Palmer's Iron and Shipbuilding Company, Limited, Jarrow, is one of the firms which have been asked by the Admiralty to tender for three steel cruisers. Dulness prevails in all branches of the coal trade, irrespective of the holidays, which at most places stopped work for a couple of days in the beginning of the week—a much shorter respite than is indulged in by the miners in some other coalfields. Steam-coals are in rather better demand than other sorts, and the collieries have been somewhat busier, but far from brisk. The proprietors of steam-coal collieries remain, however, hopeful of the future of the trade; for whilst they submit, in many instances, to 6d. to 9d. per ton abatement from the fixed price of 10s. per ton, less 2½ per cent., for immediate shipment, in all cases of inquiry as to forward contracts they are stiff and unyielding. Unscreened coals for gas and manufacturing purposes do not sell so freely as they did a week or two ago, when the Baltic demand was at full tide; and now loading turns are very short, and at some of the pits a slight curtailment of work has been found necessary. Best gas-coals are still 7s. 6d. per ton, free on board in the Tyne or Wear, nominally, but purchasers for immediate requirements can obtain good concessions. House-coals are still difficult to sell, and prices are so variable, and depend so much on quantity and other circumstances, that quotations can scarcely be attempted. For coke of all qualities the inquiry is extremely limited and prices are low. Good blast-furnace coke can be had from 10s. to 11s. per ton at the ovens, and foundry descriptions for 2s. more, with the customary discount. The engine works in this district have orders enough to keep them going briskly for some time to come, mostly marine work, but the holidays have interfered with operations for a few days; forges also are busily employed. There is no improvement to note in the chemical trade. During the past week prices have again fallen, and the prospect is not bright. Shipments are proceeded with in fair quantities, but the greater part of them are under old contracts. Present quotations for immediate delivery are as follows:—Soda ash, 48 to 52 per cent., 1½d. net; refined alkali, 52 per cent., 1¼d. less 5 per cent.; bleaching powder, £5; soda crystals, £3 less 2½ per cent.; bi-carbonate of soda, £10 less 2½ per cent.; sulphate of soda, in bulk, £2 17s. 6d. Firebricks are not selling so quickly for export; the shipments that are being made are on old contracts, and there is a dearth of new business. Prices are somewhat easier, ranging from 42s. 6d. to 50s. per 1000. The last named figure is Messrs. Ramsay's price for export, but they are quoting 45s. for the London market, less 2½ per cent. Cochran Carr's are 45s. net, and Walbottle the same, less usual discount. Lead and copper works are active, and cement makers do a good business.

NORTH STAFFORDSHIRE.—The recurrence of the Whitsuntide holidays has not had any noticeable influence on the iron and coal trades in this district The average amount of business done has for several weeks been too limited to be much further reduced; but in some cases the forges and mills were again set to work on Monday night, though the bulk of them started later on. Reports have been again in circulation to the effect that a renewal of the American demand would commence shortly; but as yet there is no substantial ground for the notion in view, and the home market shows few signs of a return to activity. Tenders for boiler and ship plates are rather more numerous than they have been; and girders, channels, and other large sections are in better demand, but hoops are little called for, and the bar department is quiet. Puddled bars are in poor request, although the forges are making fair time. Prices are a trifle steadier in the finished-iron trade, but, while makers of well-known brands refuse to accept the very low figures sometimes offered, the decline in rates has not been generally suspended. There is no improvement whatever in the pig-iron and ironstone trades, and the sale of coal continues languid. Prices in all three departments are reduced, and of fuel are, as a rule, unremunerative. The strike already noticed at the Talke and Harecastle collieries continues; but no attempt has yet been made to reduce wages generally among the miners of the district.

SHEFFIELD.—There has been very little business indeed done in Sheffield this week. Whitsuntide holidays are always held over a period of three days here. There has been no speculation whatever during the past week, all persons being anxious as to what course events will take after the holidays. Heavy losses have been incurred in the town by the sudden and unexpected drop in the value of all classes of Bessemer and Siemens steel. Seventy five per cent has in some cases been the extent of the depreciation within a few weeks. Lots are now on offer as follows:—Billets, No. 1. £7 10s.; inferior £7 5s., and scrap in proportion. Little trade is doing, and we hear of one or two houses in the trade being embarrassed by this unlooked-for turn in events. The iron trade is slack, and revised lists sent out this morning indicate bar £8 10s. per ton nett, hoops £10 10s.; sheet £12 10s.; sickle rods £10 10s. Other varieties show a like falling off. Where the mills resume work there is plenty of work for them to continue on at present. There are still large orders in the town for railway material, booked at higher rates than those now prevailing. When these are run out it is difficult to say what course will be taken. There are evidences of intended reductions in the wages of iron workers. Cutlery manufacturers find more business on their hands than at the commencement of the spring season, and even during the holidays large orders have been booked, principally on foreign account. During this week, however, there will be few trade alterations.

SOUTH STAFFORDSHIRE.—The works and factories have been mostly laid off up to the middle of this week consequent upon the occurrence of the holidays, and in numerous instances little or nothing will be done the week through. The orders that are accumulating upon manufacturers' books are not large, still there will be plenty of work upon which to resume. Manufacturers have not yet received all the indents which merchants got by the last mail from Melbourne, and they therefore expect that a better report will be possible next week. The Antipodean advices state that the only activity in the metal market has been in the commodity of galvanised sheets. An increasing business is doing with the leading consuming centres in Scotland, and the quality of the manufactures which are being sent thither is generally speaking of a superior grade. Prices of hardwares continue to recede. Since last report fry pans have been increased in discount 2½ per cent., the existing discount being 67½ per cent. Galvanised buckets are lowered 3d. per dozen. The rim and mortise lock makers of Willenhall, and the currycomb makers of the same town, are executing orders at a 10 per cent. drop upon the prices which they quoted before iron began to decline. The galvanisers are receiving some good sheet orders from Buenos Ayres and the River Plate, and enquiries from the Cape are also improved. Canadian season corrugated sheet orders are not arriving with freedom. Prices vary from £17 to £18 for 24 w.g. in bundles. For 26 w.g. a farther £2 per ton is demanded. The firm attitude of the spelter market is regarded by the galvanisers with favours.

WEST CUMBERLAND.—At most of the works in the district this week has been observed as a general holiday, and as a consequence, except at the furnaces, which it would be impossible to stop, unless a great loss was incurred, there has been, industrially speaking, very little done during the past few days. There is an equal amount of quietness in the business connected with the iron trade. The demand is quiet and sales are very few. Prices have come down as quickly as they went up at the close of last year, and the low value of iron may be expected to continue so long as makers have so many orders in hand and so many deliveries to make, inasmuch as with an improved demand at the present moment it is probable prices would again move upwards to a point at which buyers would not be disposed to purchase metal. The output of the furnaces is almost at its maximum, and several new furnaces are being prepared for being put into blast at an early date, all indications of the confidence felt in the future of the iron trade of the district. Deliveries to foreign buyers are very large, and as a consequence shipping is very briskly employed. The traffic receipts on local railways also testifies to the very considerable tonnage of raw and manufactured material passing over the lines, and a comparison with previous years shows the improvement which has taken place. The question arises as to whether the decline in demand will ultimately compel makers to decrease the output of their works; but this seems hardly possible with the prospect there is of buyers being able to do a steady business at what will be considered moderate prices. Several inquiries are now being made for terms of forward delivery. Steel makers are very busily employed, and there is not only a very considerable output of rails, but merchant qualities are in increased production, and they meet with great favour. Ship builders are not doing much work. Finished-iron workers busy. Iron ore quiet, but a large delivery. Coal a shade weaker.

A BIG DAY'S WORK.—On the 10th inst. 103½ tons of fifty-pound rails were manufactured at the Philadelphia and Reading Coal and Iron Company's mill at Reading. This is said to be the biggest day's work done at this mill since it was built. The heating furnaces having been widened some eighteen inches, longer rails can now be made. Four new boilers are now being placed in the rolling mill.—*Railway World.*

CONTINENTAL MINING AND METALLURGY.

FRANCE.

THE weakeness of foreign markets causes apprehensions in France as to the chances of stability of the home trade; at present, however, prices are not at their weakest, nor work at its scantiest. In Paris, indeed, and in the districts of the north, the Loire and the Rhone, there is an exceptional amount of activity in special branches of trade. To the demand for iron caused by the general activity of the building trade at Paris has now to be added that arising from the rebuilding of the Paris Post Office and of the Orleans railway station. Building in the provinces is also more than usually brisk, and the hopes of the iron trade are supported by the harvest prospects. On the other hand trade is weak on every frontier of France, and foreign goods are seen ready to break through them. The cessation of the American demand is deplored more perhaps than need be, and it is noted that old rails no longer keep up their former high price.

Recent tenders accepted by the railways show that the latter are still willing to pay living prices, and prove that competition is far from having regained its former severity. On May 1st tenders were let at Périgueux for 2850 tons of double-headed steel rails, and 130 tons of iron fish plates. Both lots of goods were taken by Chatillon-Commentry, rails 310 fr. (£12 6s.), the fish plates at 239 fr. (£8 9s. 9d.). Other offers for the latter were made by Sirot (240 fr.), Vezin-Aulnoye (255 fr.), Commentry - Fourchambault (268 fr.). These goods had been put up to tender by the State on January 30th last, at an upset price of 240 fr. The takers consented to pay £2 15s. 6d., or 70 fr. more than they were willing to pay at the end of January, and thus gave an excellent example to buyers generally. In the case of another lot of 3154 tons of steel rails for delivery from next September, the specification fixed the upset price of 280 fr. No offer came down to this, and the lot will have to be offered again.

The Braca tramrail, which weighs 44 kilos the metre run, has a T section with an extra broad foot, and is laid directly upon the soil, is being put down for trial in the rue de Rome.

In north-eastern France pig-makers continue work on old contracts, some of which will last into the autumn, but sundry projects for the blowing-in of fresh furnaces have been nipped in the bud. English foundry pig is finding its way into the departments of Haute-Marne, Meurthe-et-Moselles, Ardennes, &c. *La Houille*, of the 16th inst., states that M. Taskin, who held a license for making steel by the Thomas process on any point of the soil of France, sold it to Messrs. Schneider and De Wendel, who have made over their monopoly for paid-up shares worth £32,000 in a new company which has been formed for the manufacture of basic steel—the company's works being situated in the neighbourhood of Longwy. Another company, according to the same authority, has been formed for the same purpose among some of the Longwy manufacturers, who have come to an arrangement with the holders of the licence for Meurthe-et-Moselle, and have taken over the ironstone mines and iron-making plant formerly belonging to Baron Adelsward and M. Labbé, intending to put up at Mont Saint Martin mills for working up the ingots into finished goods. The north-east of France thus gains very largely in manufacturing importance. M. de Wendel is said, also, to have had good success in his dephosphorisation experiments at Styring.

The burning fountain at Saint Barthelémy, which for ages has been one of the wonders of Dauphiny, has at last been laid hold of by an American engineer, who has been burning cement with the gas got from it, and is putting up a large gas-holder to store the gas for commercial purposes. It is intended to sink a shaft for getting at the petroleum which is supposed to underlie the ground whence the gas escapes.

M. Dumas has been heating magnesium and aluminium in vacuo, and finds that both these bodies, as found in commerce, contain hydrogen, magnesium a volume and a half, aluminium about its own volume. M. Dumas is following up the general subject of the occlusion of various gases by various metals.

BELGIUM.—There seems some possibility that the belief in a partial recovery after June will be realised. The fluctuations of the Belgian market, which has been as unsteady as the English, are now visibly restrained within narrower limits, and within the past few days prices have been held with tolerable firmness, and the disposition of the trade has improved. A better tendency is visible in the course of industrial and colliery shares; the demand is far from brisk, but the Stock Exchange is acting on the belief that the worst, for the present, is past. At the Brussels Exchange buyers are compelled to pay 80 fr. for white pig, and 110 fr. for grey. Bessemer pig is offered more freely, although steelworks are tolerably full, and steel itself not weak. Great annoyance is manifested on the Exchange at the delay of the Government in approving or rejecting the tenders for the large amount of rolling stock on which the trade of Belgium has for some time been reckoning. On the other hand, the publication of the rates of the tenders is said to have brought business from abroad to Belgian houses, so that the misfortune of their not being able to put the Belgian minister of works under their thumb has received a certain mitigation.

The standard prices for iron are held firmly on the base of 150 fr. at Charleroi, and 155 fr. to 160 fr. at Liége. Inquiries are being received in both districts, and in Charleroi at least are in some cases followed by business. Wire is favoured; forged and machine nails and Paris points are dull.

The *Moniteur belge* of the 12th publishes the authorisation, first applied for in 1877, for the erection of puddling furnaces, steam hammers, and wire mills at Dampremy. The conditions on which this authorisation are granted are ten in number, comprising among them the subjection of the works to the officers of mines appointed by the State as inspectors for general and statistical purposes, the maintainance of a sick fund, the inspection of boilers, and the payment to the State of £6 a year towards cost of inspection.

The balance sheet of the Forges d'Acoz, made up to April 30th, shows a profit of about £12,000. The company has work in hand sufficient to employ every branch of its works for five months to come.

In the discussion in the Senate on May 12th, on a proposed line of rail from Marloie to Bastogne, M. de Xivry stated that the main line would pass through newly discovered deposits of ironstone containing from 52 to 58 per cent. iron, Luxembourg minettes containing only from 32 to 33 per cent. Thousands of truckloads could be furnished every year, according to the speaker.

The latest number of the *Revue Universelle* contains the translation of a lengthy study by D. K. Chernoff, on the structure of steel in cast ingots. This study was communicated in December, 1878, to the Russian Imperial Technical Society, and has been translated from the Russian by M. Czernewsky. It is illustrated by several lithographic drawings.

The *Moniteur belge* of the 27th ult. gives the following account of furnaces and ironworks in Belgium during the second half of 1879:—

Coke furnaces on blast, 25; cold, 42; works open, 16; closed, 13; workmen employed, 2480.

Make of pig during half year:—

	tons.	Average selling price per ton. fr.	£	s.	d.
Foundry pig	22,600	62·87 =	2	9	10
Forge pig	163,664	48·32	1	18	3
Bessemer pig	35,677	84·24	3	7	0

Ironworks open, 42; closed, 11; puddling furnaces at work, 449; cold, 259; reheating furnaces at work, 182; cold, 128; hands employed, 13,260.

Make of various irons during half year 219,873 tons; average selling price 142 fr. 68 (£5 13s. 0d.)

Bringing forward the returns for the first half of last year and combining with the above, we get the following totals of make (in metric tons) for 1879:—

	Foundry pig.	Forge pig.	Bessemer pig.	Irons.
1st half	29,338	173,728	23,364	190,654
2nd „	22,600	163,664	35,677	219,873
Totals (1879)	51,938	337,392	59,041	410,527

The *Annuaire statistique* publishes sundry particulars concerning the general state of Belgium during 1879. On December 31, 1878, the population was 5,476,939; the number of persons engaged in mining and metallurgy was 163,810 in 1878; in coal mining, men, 59,007, women, 4327, boys under 16, 9679; girls under 16, 2823. About 3000 patents a year are taken out in Belgium.

Coal has acquired firmness, and instead of continuing to make monthly contracts manufacturers are in many cases extending the length of their engagements.

GERMANY.—The news from Germany are of mixed complexion. In Siegerland the demand for pig and ironstone has almost ceased, and the mills are keeping open only to work up for stock, or to refurbish their plant. The larger blast-furnaces are mostly secured by long-term contracts taken at fair rates, but the smaller furnaces are in a state of distress. They offer small parcels at low rates, without finding takers. Most of the neighbouring furnaces have got their stocks of ironstone, and sales are slow at 11s. for spathose ore, 12s. for brown hematite, and 17s. for calcined spar. On the Lahn, all metallurgical operations are in full swing, and ironstone owners are engaging fresh hands. Mineral trains usually numbering 40 to 50 trucks, are lengthened to 65 or 70, and with every effort it is difficult to keep the lines clear.

The decline in Westphalia makes itself strongly felt in pig-iron. Luxembourg makers still hold to their syndicate price of 60s., but they have now to meet the competition of Siegen makers, who bring a better article to market at the same rate. Not long since, Siegen pig brought 100 per cent. more than Luxembourg pig. No fresh lowering of finished irons is announced, but consumers of raw material from Luxembourg can hardly afford to go lower, and will hardly care to begin again to sell at cost price. There are inquiries, too, sufficient to show that there is yet some life in trade although the inquiries show a belief on the part of consumers that prices have not yet touched the bottom. The owners of the Dortmund Mills are not yet discouraged, are prompt in improving plant or methods of work and are not turning away hands. Machinery builders are really well employed, and are engaging fresh workmen.

The trade of Eastern Germany is but little more homogeneous than that of Westphalia. Coke-pig is weak, with a falling demand; the mills are mostly provided with large stocks, and the furnaces are engaged on old contracts, but are anxious for fresh ones to supply the place of those now being rapidly worked out. Puddled bars are neglected, and merchant bars sell slowly. Orders from machine and carriage builders are few, and the merchants are doing little. Wire is dull; the mills offer lower terms, but dealers are confident that still lower will yet be made, and refuse to buy.

The Alsace-Lorraine Railway has let tenders to German houses for 500 goods and coke trucks.

The following is a sketch of the condition of the iron trade in Upper Silesia during 1879:—

During the first three-quarters of the year business was as bad as in 1878; an improvement began to be noticed at the beginning of the fourth quarter. Coke pig, which had sunk to 49s., and bars, which had gone down to 97s. 6d., fetched almost double at the end of the year. The rise in pig was caused by the scarcity of the English article and the rise of warrants. As soon as pig began to get scarce business was aroused, and considerable contracts were entered upon for supplies during the first and second quarter of 1879 at 60s. to 66s. At the end of the year there was no stock left at Upper Silesian furnaces, although the exports to Austria had not been strong.

The pig here quoted is forge pig; foundry pig cannot be made in Silesia so cheaply as English and Scotch can be imported. The make of charcoal pig is already very small, and is steadily declining.

Puddled bars sank during the year to 76s. An improvement took place during the last quarter proportioned to the rise in pig, but the consumption was almost entirely limited to the mills of Upper Silesia, exportation to Austria being hindered by the high duty. Bars, which had been declining during 1878, came down to 100s. in March, 1879, and remained low till towards the end of the year, when 20s. was realised; the sales of wire were maintained by a policy of close cutting in price. This was forced on Silesian mills by the efforts of Westphalia wire-makers to found a market in Silesia at any cost. Prices improved towards the end of 1879. Exports to Austria and Russia were small, by reason of the heavy duties.

Plates rose, as they usually do towards the autumn.

The two principal branches of trade in Silesia, pig-making and ironmaking, suffered severely. The best-managed works, in possession of their own supplies of ironstone and fuel, were unable to make at a profit at the prices ruling during the first three quarters of 1879. The products of the mills had never before been quoted so low. Materials were low, coal expensive, and reductions in wages were impossible. In the autumn, indeed, there was a famine in the flat lands of Upper Silesia. The trade has reason to be thankful for the re-imposition, on July 1, 1879, of the import duties on iron, and for the American demand.

The *Wochenschrift*, for May 15th, of the German Engineers' Association, describes a new system of three-high roll patented by Mr. C. Erdmann, and adopted for several trains in the Duisburg Engineering Works. The system, however, does not meet the views of Vahlkampf or Dacleu.

NEW PATENTS.

ALL the Patents are placed Alphabetically, with the official numbers attached. The New Applications range from No. 1917 to No. 2011, being the entries from May 11th, to May 17th.

NEW APPLICATIONS.

Accumulator Pump.—*J. L. Anderson, Wandsworth Common, Surrey.* [1923
Adjusting Mariners' Compass.—*H. J. Thatcher, Cardiff.* [1934
Alarm Signals.—A communication.—*W. P. Thompson, London.* [1942
Anthracene.—*J. Hardman, Miles Platting, near Manchester.* [1959
Anthracene.—*G. Wischin, Prague, Austria.* [1980
Apparatus for Exhibiting Goods.—A communication.—*H. J. Haddan, London.* [1982
Apparatus for Teaching Children to Walk.—A communication.—*H. J. Allison, London.* [1939
Bakers' Ovens.—A communication.—*G. and H. Coles, Clapton, London.* [1979
Bicycles.—*J. Hall, Sheffield.* [2007
Blotting Pad.—*D. Wishart Kilmarnock.* [1965
Bobbins.—*L. Wilson, Manchester.* [2002
Boiling Worts.—*J. C. Wilson, Newry Brewery, Ireland.* [1967
Boot Heel Irons.—A communication.—*W. A. Barlow, London.* [1957
Braces.—*W. H. Key, London.* [1953
Brickmaking.—*J. Snape and J. A. Noel, Aberaman Works, near Aberdare.* [1993
Breechloaders.—*C. G. Bonehill and W. J. Matthews, Birmingham.* [1952
Calculating Machines.—*E. Geny, Paris.* [2003
Cast-iron Bullets.—*T. Nordenfelt, London.* [1940
Chains for Driving Machinery.—*H. Baird, Birmingham.* [1943
Checking Fares.—*G. H. Manton, Liverpool.* [1935
Chimney Sweeping Apparatus.—*C. Rouse, Chislehurst.* [1918
Coating Metal.—*T. L. Switzer, Newport, Isle of Wight.* [1966
Confectionery.—*L. Collier, jun., Rochdale.* [1984
Coupling and other Apparatus.—*G. Turton, London.* [1975
Crayon Holders.—*J. Illfelder, Fürth, Bavaria.* [1944
Cutting, &c., of Metal.—A communication.—*W. A. Barlow, London.* [1920
Cutting Tulles, Laces, &c.—*L. O. Deschamps, Paris.* [1983
Distributing Sound in Buildings.—*A. C. Engert, Bromley-by-Bow, Middlesex.* [1955
Drawing Ellipses.—A communication.—*F. Wirth, Frankfort-on-the-Main, Germany.* [1989
Drilling Machines.—*T. Naish, Birmingham.* [1977
Drying Stoneware.—*J. Snape and J. A. Noel, Aberaman Works, near Aberdare.* [1994
Ears for Buckets.—*E. I. H. E. Whitehouse and J. T. Whitehouse, Coseley, Staffordshire.* [1976
Extension Ladders.—*J. E. Richards, New York, U.S.A.* [1931
Fertilising Compounds.—A communication.—*H. H. Lake, London.* [1919
Fire-places.—*J. Turnock, Ross, Herefordshire.* [1985
Fluid Meters.—*J. Urquhart, Manchester.* [2001
Flour Mills.—A communication.—*H. J. Haddan, London.* [1928
Game of Base.—*P. F. Walker, London.* [1924
Gas Engines.—*W. B. Haigh and J. Nuttall, Oldham.* [1969
Grate Bars.—*G. Hibbert, Richmond, Yorkshire, and L. Cooke, Horwich, Lancashire.* [1949
Grinding Apparatus.—A communication.—*W. Clark, Chancery Lane, London.* [1996
Hydrants.—*J. Chidley, Cutsdean, Worcestershire.* [1951
Ice-making Apparatus.—A communication.—*C. Pieper, Berlin, Prussia.* [2010
Improvements in Chèques, &c.—*A. T. King, Nottingham.* [2011
Knife and Umbrella Handles.—*S. Staight, London.* [1982
Lamps.—*J. Thomas, London.* [1999
Lithography and Printing.—*G. Harrison, Bradford.* [1991
Looms.—*R. Moss, Preston, Lancashire.* [1963
Magneto-Electric Machines.—A communication.—*W. R. Lake, London.* [1998
Malt Drying Apparatus.—*A. J. Reynolds, London.* [2000
Malt Liquors.—*M. Mèrichenski, London.* [1972
Motor Engine.—*J. McPherson, Liverpool.* [1948
Nut-making Machinery.—*J. P. Binns, Halifax.* [1973
Packing Cases, &c.—*E. I. Billing, Gloucester.* [1968
Paint Brushes.—*E. Wright, Gainsborough, Lincolnshire.* [1930
Paper Bags.—A communication.—*E. P. Alexander, London.* [1981
Pianofortes.—A communication.—*G. W. von Nawrocki, Berlin, Germany.* [2005
Pickling Metal Plates.—*L. Howell, Taibach, Glamorganshire.* [1929
Plates for Printing.—*A. Sauvee, London.* [1961
Plaiting or Kilting Machines.—A communication.—*W. R. Lake, London.* [1932
Ploughs.—*E. G. Lakeman, Modbury.* [1941
Printing Apparatus.—*M. Bebro, London.* [1917
Preventing Radiation of Heat in Boilers, &c.—*J. G. Cameron, Kingston-upon-Hull.* [1997
Propulsion and Steering of Ships.—*G. Pfannkuche, sen., Vienna, and G. Pfannkuche, jun., London.* [1990
Reaping Machines.—*A. McGregor, Leigh, Lancashire.* [2004
Registering Tickets.—*E. Braubach, London.* [1978
Regulating Flow of Water.—*F. P. Preston, J. T. Prestige and E. J. Preston, Deptford.* [1933
Screw Propellers.—*J. H. Thomas, London.* [1974
Screw Propellers.—*I. Kosztovits, Wieselburg, Hungary.* [1947
Screwing Machinery.—*H. Waite, Smethwick.* [2009
Steam Cultivating Engines.—*B. Fowler, R. Burton and R. H. Shaw, Leeds.* [1988
Skirt Waist Bands.—A communication.—*E. K. Dutton, Manchester.* [1938
Steam Boilers and Joints.—*E. A. Bourry, Saint Gall, Switzerland.* [1987
Sound Articulators.—A communication.—*W. Clark, Chancery Lane, London.* [1954
Sponge Baths.—*J. Laitwood, Timperley, near Manchester.* [1950
Spring Mattresses.—A communication.—*S. Ullman, London.* [1925
Stone Breakers.—*S. Marshall, Leicester, Leicestershire.* [1964
Sulphurous Acid Gas.—*C. Humfrey, Chester, Cheshire.* [1921
Tailors' Measuring Apparatus.—*J. Hepple, Gateshead.* [1992
Telegraph Insulators.—*G. Wells, London, and A. Gilbert, Worcester Park, Surrey.* [1960
Telephones.—A communication.—*J. H. Johnson, London.* [1958
Textile Fabrics.—A communication.—*S. Bowden, London.* [1962
Tow Scutching Machine.—*J. Robinson, Cookstown.* [1956
Twisting and Doubling Thread.—*J. Clough, Haincliffe, Yorkshire.* [1926
Umbrellas.—A communication.—*B. Hunt, London.* [1970
Umbrellas.—*J. T. and F. S. Liley, London.* [1995
Vegetable Colouring Substance.—*M. E. Savigny and A. C. Collineau, Paris.* [1971
Velocipedes.—A communication.—*W. R. Lake, London.* [1937
Ventilation of Carriages.—*H. Shiels, Leith, Midlothian.* [2006
Ventilators.—*W. Hickey and S. Barnett, Tonbridge Street, Middlesex.* [1946
Walking Sticks.—*C. Jacquelin, Paris.* [1936
Waterclosets.—*C. E. Monkhouse, Penge, Surrey.* [1915
Waterclosets.—*S. B. Goslin and J. J. Brown, London.* [1988
Water Heating Apparatus.—*A. K. Irvine, Glasgow.* [1927
Wire Cards.—*G. and E. Ashworth, Manchester.* [1986

ABSTRACTS OF METALLURGICAL SPECIFICATIONS,

PUBLISHED DURING THE WEEK ENDING MAY 15, 1880.

(By Philip M. Justice, 14, Southampton Buildings, W.C.)

4093 (1879).—Kidd and Green.—Iron.—The ordinary blast is produced, conveyed, heated and passed into the blast-furnace in the usual manner. Between the receiver into which the blast is pumped and the distributing pipes to the tuyeres, a second pipe, fitted with valve and index, is arranged so that cold blast may be admitted to reduce the quality of the metal to any point desired. The iron is claimed to be cleaner, stronger and tougher.

4110 (1879).—Bessemer and Bessemer.—Tin-plate Bar.—Old steel rails are flattened down and decarburised into soft iron in closed cast iron or steel retorts, between layers of iron ore or oxides of iron or manganese.

4117 (1879).—Alexander and McCosh.—Blast Furnace Gases.—The gases are taken by a pipe from the top of the furnace to condensers provided with outlets for withdrawing tar and other liquefied matters; thence through washers to remove ammoniacal or soluble volatile substances. The gases are drawn through the apparatus by a blower and fed to stoves for heating blast or furnaces.

4141 (1879).—Clark, communicated by Launay and Launay.—Steel.—Bar, scrap or other iron is placed in a crucible, together with carbonised powder, crushed corozo nuts, or vegetable ivory turnings. The metal then undergoes the ordinary process of cementation, and the steel produced is claimed to be especially suited for making metal-working tools.

507 (1880).—Johnson, communicated by Designolle.—Extracting Gold and Precious Metals from their Ores.—Amalgamation is effected by an electro-chemical process, combined with powerful mechanical action. The coarsely pulverised ore together with water containing preferably bichloride of mercury and chloride of sodium is fed into a horizontal sheet-iron cylinder, containing a quantity of cast iron balls, the amalgamation and grinding being effected during the rotation of the machine. The amalgam is collected by feeding the ground ore from the amalgamating cylinder into the top of a cylindrical case provided alternately with revolving amalgamated discs, and stationary amalgamated shelves.

COMMERCIAL.

J. BERGER SPENCE AND CO.'S WEEKLY REPORT.

CHEMICALS.—There is still a considerable amount of quietness prevailing in respect to chemicals, nor as far as can be discerned are there any signs of impending improvement. Certainly there has been an increase in the number of inquiries, both from the foreign and home constituencies, but the amount of business resulting shows that many of these are made only for the purpose of testing the markets. The continued weakness in values, and the prevalent downward tendency prevents buyers from operating beyond the most limited extent, notwithstanding the increasing anxiety of manufacturers to make sales by offering additional inducements. From this it may be gathered that the position is rather less favourable for makers than was the case last week. There can be no doubt, however, that as prices have now made a considerable retreat from the late, to some extent unjustifiable inflation, consumers are on the *qui vive* for the least indication that the downward course has been arrested in order to operate. Any improvement, therefore, is likely to be well sustained for a time. During the week the quotations for bleaching powder, caustic soda, ash, and alkali generally, have been principally nominal, and transactions have been dependent upon the exigencies under which buyers and sellers have laboured. Sulphate of copper is easier. Limesalt is rather slow of sale, consumers being fairly covered. Arsenic remains steady.

MINERALS.—This branch of commerce continues to feel the influence of the disturbance in kindred branches, and rade becomes more restricted to actual wants only. At the moment there is a complete absence of all speculation, and some apprehensions are felt that the exceedingly heavy stocks of last summer may be again accumulated. Brimstone continues weak. Foreign advices do not indulge in favourable prospects, although the exports will, it is thought, be maintained for the remainder of the month, forward values have lost any advantages over those for current delivery. During April there were 20,443 tons of sulphur exported from Girgenti; 4611 tons from Licata; and 12,911 tons from Catania; making a total of 37,965 tons. Copper ores bring rather good prices, considering the position of the metal. On the 11th inst., at a sale of copper ores, &c., at Swansea, 1089 tons realised £8726 16s. 6d.; and as the average produce was 13¾ per cent., the average price per unit was 11s. 8¼d. Manganese is in good request. Iron ore is still drooping. China clay is without any material change.

METALS.—The satisfactory tone noticeable in the pig-iron trade last week has not been been sustained. The demand has become easier this week, and the action of the holders of second-hand parcels have rather disturbed the improving condition lately noticeable. The immediate consequence is a loss of the firmness in value and a difficulty in inducing buyers to operate freely. Glasgow warrants have receded from 46s. 6d., and may be now brought as low as 45s. 6d. At the moment, however, the market seems steadier. At Middlesborough the bulk of the trade is being done by merchants, principally at speculative figures. Makers are holding off the market fairly well, and as the shipments are tolerably heavy, this action will have a tendency to arrest the downward disposition of values. Hematites are still unsteady, and new orders scarce. Lead is cheaper. English makers, however, refuse to sell at present prices. A fair business has been done in tin. Copper is slightly better.

GENERAL ITEMS.—The iron trade of France comprises 428 separate works, employing 120,000 hands, which, with those dependent on them, reached a total of 900,000 souls. The works are served by 1490 steam-engines and 829 hydraulic motors. The total weight of pig-iron made averages 1,400,000 tons per annum.

Manchester, May 15th, 1880.

JAMES H. WEAGER AND CO.'S METAL REPORT.

THERE is much depression existing in the metal market here and elsewhere generally, operaters evincing not much confidence. Iron: Scotch pigs showed but little animation. Prices for warrants have varied from 45s. 6d. and 46s. 1½d Copper, large parcels of Chili have changed hands at reduced rates. Tin: extensive "bearing" operations have force down prices, but there can be little doubt also that large sales have been made of parcels bought at considerably higher prices, than are now ruling. We cannot look upon the present aspect of tin as being its legitimate position, but while there are a few sellers at these prices of course buyers will not pay more. The selling portion of the market, however, is very circumscribed. Lead: quiet with little inquiry. Tin-plates: more inquiry about, but prices are capricious.

LONDON PRICE LIST OF METALS, ORES, OILS, CHEMICALS, &c.

[FOR THE PRESENT AND PAST WEEK.]

Metal Market, City, Thursday Afternoon, 4 P.M.

(*May* 20, 1880.)

METALS AND ORES.

	MAY 13.		MAY 20.	
COPPER (per ton)—	£ s.	£ s.	£ s.	£ s.
Chili, for 96 per cent.	55 10/	—	55 10/	—
Wallaroo	74 0/	—	74 0/	—
Burra Burra	72 0/	—	72 0/	—
English Tough	62 0/	—	62 0/	—
English Ingot best	63 0/	—	63 0/	—
Sheets sheathing and rod	70 0/	—	70 0/	—
Bottoms	76 0/	—	76 0/	—
Ore per unit	0 13/	0 13 6	0 13/	0 13 6
PHOSPHOR BRONZE				
Special Bearing Metal (p tn)	116 0/	—	116 0/	—
Other alloys (per ton	123 0/	139 0/	123 0/	139 0/
TIN (per ton)—				
Straits (Cash)	76 10/	—	74 0/	—
Do. for arr.	—	—	—	—
Billiton	—	—	—	—
Banca	—	—	—	—
English Ingots	83 0/	—	82 0/	82 0/
Do. Bars	84 0/	—	81 0/	83 /0
Do. Refined	86 0/	—	85 0/	—
Australian	76 10/	—	74 0/	—
TIN PLATES, per box, I.C. coke f.o.b. London	0 19/	0 21/	0 18/	0 20/
IX. do.	0 24/	0 26/	0 23/	0 28/
I.C. charcoal	0 21/	0 25/	0 21/	0 26/
I.X ,,	0 27/	0 31/	0 27/	0 32/
LEAD (per ton)—				
Soft English pig	15 10/	—	15 0/	—
Do. W.B.	—	—	—	—
Spanish soft	14 15/	—	14 10/	—
Do. with silver	—	—	—	—
Sheet milled	16 0/	—	16 0/	—
Red lead	17 10/	—	17 10/	—
White	22 0/	—	22 0/	—
Patent shot	19 0/	—	19 0/	—
ZINC (per ton)—from No. 9 Gauge.				
Sheets, rolled	23 10/	—	23 5/	—
Do., foreign	24 0/	—	24 0/	—
SPELTER (per ton)—				
Silesian, com	19 5/	—	19 5/	—
Rhenish	—	—	—	—
English	—	—	—	—
QUICKSILVER, bot.	6 12 6	—	6 12 6	—
ANTIMONY ore (per ton)—				
Australian	11 10/	14 10/	11 10/	14 10/
Spanish	—	—	—	—
French Star	69 0/	—	69 0/	—
Regulus—				
Crude (per cwt.)	1 14/	—	1 14/	—
NICKEL (per lb.)	0 3/6	—	0 3/6	—
BRASS (per lb.)—				
Sheets, 48 × 24.	0 0/8	—	0 0/8	—
Tubes	0 0/11	0 1/	0 0/11	0 1/
Wire	0 0/8½	—	0 0/8½	—
Yellow metal	0 0/6	0 0 6¼	0 0/6	0 0 6¼
ASBESTOS (per lb.)	0 0/3	0 0 6¼	0 0/3	0 0 6¼
PLUMBAGO (per ton)—				
Ceylon lump	0 17/6	—	0 17/6	—
Do. chip	0 10 6	—	0 10 6	—
Do. dust	8 6/	—	8 6/	—
COALS (per ton)—				
East Hartlepool	1 2/	—	1 2/	—
Lambton	1 4/	—	1 4/	—
Tees	1 4/	—	1 4/	—
Hartley	1 2/	—	1 2/	—
Hetton	1 4/	—	1 4/	—
Hawthorn	1 3/	—	1 3/	—
Tunstall	1 2/	—	1 2/	—

OILS, CHEMICALS, &c.

	MAY 13.		MAY 20.	
OILS (per ton)—	£ s.	£ s.	£ s.	£ s.
Olive, Malaga	—	—	—	—
Do. Gioja	44 10/	—	44 10/	—
Do. Levant	42 0/	43 0/	41 0/	43 0/
Do. Mogador	—	—	—	—
Do. Tunis	—	—	—	—
Do. Seville	44 10/	45 0/	44 10/	45 0/
Do. Sicily	45 0/	46 0/	45 0/	46 0/
Seal, pale	29 0/	29 10/	29 0/	29 10/
Seal, yellow	27 0/	—	27 0/	—
Seal, brown	25 0/	—	25 0/	—
Sperm head	75 0/	—	72 0/	—
Cod	26 0/	26 10/	26 0/	26 10/
Whale, pale	26 10/	—	26 10/	—
Do. yellow	25 10/	—	25 10/	—
Do. brown	20 0/	—	20 0/	—
E.I. Fish	—	—	—	—
Rapeseed, English, pale	29 15/	—	27 10/	—
Do. brown	27 10/	27 15/	27 10/	—
Foreign Pale	—	—	—	—
Ground nut and Gingelly Madr.	30 10/	31 0/	30 10/	31 0/
Palm oil, fine	31 0/	31 10/	31 0/	31 10/
Palm nut oil	32 10/	33 0/	32 10/	33 0/
Linseed oil	26 10/	26 15/	27 5/	27 10/
Cotton seed oil	26 10/	27 5	25 10/	26 0/
Lard	42 0/	44 0/	41 0/	44 0/
Cocoanut, Cochin	35 0/	37 0/	32 0/	34 0/
Do. Ceylon	33 0/	—	31 5/	32 0/
Mauritius	37 10/	—	37 10/	—
C. Price & Co.'s patent engine oil (per gal.)	0 3/6	—	0 3/6	—

	May 13. £ s.	£ s.	May 20. £ s.	£ s.
Oil Cake (per ton)—				
Linseed, Lndn.	10 0/	11 0/	10 0/	10 10/
American bis.	10 2/6	10 5/	9 15/	10 10/
Do. bags	9 2/6	9 5/	9 2/6	9 5/
Marseilles	9 5/	—	9 5/	—
Rape, English	5 0/	—	5 0/	—
Do. Foreign	—	—	—	—
Green Cotton	5 17/6	7 0/	5 17/6	—
Tallow—PYC.	43 0/	—	42 0/	—
S. Americn. Beef	35 0/	—	34 10/	—
Do. Sheep	32 10/	33 0/	32 10/	33 0/
Australian Beef	32 0/	32 5/	33 0/	—
Do. Sheep	33 10/	34 0/	35 0/	—
Rough Town Fat	14 0/	—	14 0/	—
Petroleum—				
Fine (per gal.)	0 0/5½	—	0 0/5½	—
Do. spirit	0 0/6½	0 0/7½	0 0/6½	0 0/7½
Turpentine—Spirit—				
French	—	—	—	—
American (casks)	1 15/	—	1 15/	—
Whalefins (per. ton)—				
Davis' Straits	1000 0/	—	1000 0/	—
Arctic	950 0/	1000 0/	950 0/	1000 0/
Southern	500 0/	—	500 0/	—
Brimstone (per ton)—				
Rough, 2ds Ind.	7 0/	—	7 0/	—
Do. 3rds, do	5 7/6	—	5 7/6	—
Roll	9 10/	10 5/	9 10/	10 5/
Sulphur, Flour (per cwt.)	0 10/9	0 12/6	0 10/9	0 12/6
Acid, (per lb.)				
Acetic, fine	0 0/3	0 0/3 3-14	0 0/3	0 0/3 3-14
Do. common (per gal.)	0 1/5	0 1/6	0 1/5	0 1/6
Citric	0 2/6¼	—	0 2/5	0 2/6
Muriatic fine (per cwt.)	0 4/	0 7/	0 4/	0 7/
Do. common	0 4/	0 5/	0 4/	0 5/
Nitric	0 0/4½	—	0 0/4½	—
Oxalic (per lb.)	0 0/3¾	0 0/4	0 0/3¾	0 0/4
Sulphuric, concentrated	0 0/1	0 0/1	0 1/	—
Do. Brown	0 0/0¾	0 0/1	0 0/0¾	0 0/1
Tartaric Crystal	0 1/9	—	0 1/8¾	—
Do. Pulv.	0 1/9½	—	0 1/9½	—
Ammonia—				
Carbonate, per lb.	0 0/6½	0 0/6¾	0 0/6½	0 0/6¾
Sulphate, White & grey (per ton)	0 17/9	0 18/3	0 17/9	0 18/3
Arsenic—White Lump (per ton)	23 10/	—	23 10/	—
Powdered, do.	10 15/	—	10 15/	—
Bleaching powder	0 7/9	—	0 7/6	—
Borax, Rfd., do.	3 5/	—	3 0/	—
Copperas (ton)	2 15/	3 5/	2 15/	3 5/
Bi-Sulphide Carbon (per ton)	24 10/	26 0/	24 10/	26 0/
Portland Cement—				
1st quality, in cks 400 lb. gross, inc. csks., f.o.b., Thames, per csk.	0 9/	—	0 9/	—
Do. in sks, 200lb. net (per ton)	2 0/	—	2 0/	—
Sacks extra, 1/6 each.				
Charlton White Paint (per cwt.)	1 12/	—	1 12/	—
Calley's Torbay Paint, Brown	0 30/	—	0 30/	—
Do. Red	0 34/	—	0 34/	—
Hypophosphites (per lb.)—				
Iron	0 9/3	0 10/	0 9/3	0 10/
Lime	0 5/3	0 7/	0 5/3	0 7/
Magnesia	0 9/	0 9/	0 9/	0 9/
Manganese	0 9/	0 9/	0 9/	0 9/
Soda	0 5/3	0 6/	0 5/3	0 6/
Lead (per cwt.)—				
Acetate, best	2 0/	—	1 19/	2 0/
Nitrate	1 15/	—	1 15/	—
Red (per cwt.)	0 18/	—	0 18/	—
White	1 4/	—	1 4/	—
Litharge (pr cwt.)	0 18/6	—	0 18/6	—
Lime (per ton)—				
Acetate, Grey, 85%	21 0/	—	21 0/	—
Do. Brown 70%	14 0/	—	14 0/	—
Potash—				
Bichromate (lb.)	0 0/6	—	0 0/6	—
Chlorate (pr. lb.)	0 0/6	—	0 0/6	—
Muriate, 80% ton	6 15/	—	6 15/	—
Pruss. Red (lb.)	0 1/8	0 1/10½	0 1/8	0 1/10½
Do. Yel. lb.	0 0/11½	—	0 0/11	0 0/11½
Sulphate, 80% (per ton)	9 0/	10 5/	9 0/	10 0/
Saltpetre (per cwt.)—				
Engl. refnd. kgs.	1 8/3	—	1 8/3	—
Do. barrels	1 7/3	—	1 7/3	—
Do. Bengal	0 19/6	1 1/6	0 19/6	1 1/6
Soda—				
Ash ... deg.	0 0/1 15-16	0 2/	0 0/1 15-16	0 2/
Bicarb. (per cwt.)	0 11/9	—	0 10/9	—
Caustic, 60% to 72%	0 12/	0 12/6	0 12/	0 12/6
Nitrate (per ton.)	14 10/	—	14 10/	14 15/
Crystals (per ton)	3 10/	—	3 5/	3 0/3

* Per ton extra in London, Staffordshire, 15s.; Scotch, 10s.; Lancashire, 15s.; Welsh, 10s.

LONDON PRICE LIST OF IRON.

[For the present and past week.]

(*May* 20, 1880.)

IRON.

	May 13. £ s.	£ s.	May 20. £ s.	£ s.
Iron, per ton (at works)*—				
Bars, Welsh, common	6 5/	—	6 5/	—
Do. Best	6 15/	—	6 15/	—
Scotch, Common	7 0/	7 10/	7 0/	7 10/
Do. Best	8 0/	8 10/	8 0/	8 10/
South Stafford, common	7 10/	—	7 10/	—
Do. Best	8 10/	—	8 10/	—
Sheets, singles, Cleveland	10 0/	—	10 0/	—
Staffordshire	11 0/	—	11 0/	—
Do. doubles, Staffordshire	12 10/	—	12 10/	—
Do. Lattens, Staffordshire	13 0/	—	13 0/	—
Plates, Ship, Stafford.	10 0/	—	10 0/	—
Do. Scotch	—	—	—	—
Do. Boiler, Stafford.	11 0/	—	11 0/	—
Hoops, Stafford	9 0/	—	9 0/	—
Nail Rods, Stafford	8 10/	—	8 15/	—
Swedish in Lond.	12 0/	—	12 0/	—
Angle Iron, Welsh	—	—	—	—
Do. Stafford	9 5/	—	9 5/	—
Pud. Bars, Welsh	—	—	—	—
Do. Stafford	5 15/	—	5 15/	—
Do. Scotch	—	—	—	—
Rails, Welsh	6 15/	—	6 15/	—
Do. Stafford	7 10/	—	7 10/	—
North England	6 10/	—	6 10/	—
Light Rails, Welsh	7 10/	—	7 10/	—
Do. Stafford	8 5/	—	8 5/	—
Pig Iron at Glasgow				
Scotch warrants	2 7/	—	2 6/3	—
* Do. No. 1	2 9/	3 0/	2 9/	3 0/
Cleveland, Tyne or Tees	2 0/	—	1 18/6	—
Indian Charcoal, London	—	—	—	—
Wrought Iron Girders (riveted up)	18 0/	24 0/	18 0/	24 0/
Bolts and Nuts	18 0/	21 0/	18 0/	21 0/
Fish Bolts	18 0/	23 0/	18 0/	23 0/
Washers	18 10/	19 0/	18 10/	19 0/
Rivets	15 0/	18 0/	15 0/	18 0/
Spikes	17 10/	19 10/	17 10/	19 10/

	May 13. £ s.	£ s.	May 20. £ s.	£ s.
Swedish Iron—				
f.o.b. Gottenburg, nett cash.				
Pig	—	—	—	—
Bar, rolled	11 10/	12 0/	11 10/	12 0/
Do. hammered	12 0/	12 10/	12 0/	12 10/
Billets	12 0/	—	12 0/	—
Horse Nail Rods	—	—	—	—
Belgian Iron—				
f.o.b. Antwerp, less 2½ per cent.	8 0/	—	8 0/	—
Bars and Slit Rods, common				
Best				
Best Best				
Hammered				
Puddled Steel	Nominal.			
Bessemer				
Hoops				
Rails				
Rolled Girders				
Steel—				
Best cast	40 0/	65 0/	40 0/	65 0/
Do. dbl. shear	45 0/	50 0/	45 0/	50 0/
Do. single do.	35 0/	40 0/	35 0/	40 0/
English spring med. quality	16 0/	18 0/	16 0/	18 0/
Blister	30 0/	32 0/	30 0/	32 0/
Swedish keg	16 0/	17 0/	16 0/	17 0/
Milan	20 0/	21 0/	20 0/	21 0/
Bessemer rails	7 10/	8 0/	7 10/	8 0/
Scrap (per ton)—				
Old rails for remanufacture, D.H.	3 15/	4 0/	3 12/6	3 17/6
Ditto flange or bridge	3 10/	3 15/	3 10/	3 15/
Engineers' scrap	3 10/	4 0/	3 10/	4 0/
Light scrap	2 0/	2 5/	2 0/	2 5/
Scrap metal	1 10/	2 10/	1 10/	2 10/
Old steel scrap	3 15/	4 0/	3 15/	4 0/
Wire—				
Best best drawn killed gal. tel., Nos. 0 to 6	18 10/	—	18 10/	—
Do. 7 & 8	19 10/	—	19 10/	—
Do. 9	20 5/	—	20 5/	—
Do. 10	21 0/	—	21 0/	—
Do. 11	21 10/	—	21 10/	—
Do. 12	22 10/	—	22 10/	—
Rolled black fencing wire (per ton) 1 to 4	10 10/	—	11 10/	—
Do. 5	12 0/	—	12 0/	—
Do. 6	12 10/	—	12 10/	—
Do. 7	13 0/	—	13 0/	—
Bright Iron Wire (Charcoal wire, 4s. 6d. per bundle extra) per bundle of 63 lb. 0 to 6	0 14/6	—	0 14/6	—
Do. 7 to 8	0 15/	0 15/3	0 15/	0 15/3
Galvanised, 80s. per ton extra.				
Best best annealed drawn fencing wire, per ton 0 to 6	13 15/	—	13 15/	—
Do. 7	13 15/	—	13 15/	—
Do. 8	14 0/	—	14 0/	—
Castings (per ton) at works—				
Girders	6 10/	7 10/	6 10/	7 10/
Chairs	4 10/	5 0/	4 10/	5 0/
Floor plates	5 12/6	—	5 12/6	—
Pipes, 1½ to 2in.	6 12/6	7 0/	6 12/6	7 0/
Do. 3 ,, 4	6 2/6	6 5/	6 2/6	6 5/
Do. 5 ,, 8	6 1/6	6 4/	6 1/6	6 4/
Do. 10 ,, 16	6 0/	6 2/6	6 0/	6 2/6
Do. 18 ,, 24	5 17/6	6 0/	5 17/6	6 0/
Bolts and Nuts	17 10/	20 0/	17 10/	20 0/
Fish Bolts	18 10/	21 0/	18 10/	21 0/
Spikes	17 10/	18 10/	17 10/	18 10/
Rivets	14 10/	21 0/	14 10/	21 0/
Washers	19 10/	21 10/	19 10/	21 10/

RATES OF FREIGHT.

May 20.

The current rates for coal and iron for sailing ships are:—

	Newcastle or Sunderland. s. d.	Newport, Cardiff, or Swansea. s. d.		Newcastle or Sunderland. s. d.	Newport, Cardiff, or Swansea. s. d.
Acapulco	—	26 0	Martinique	—	14 0
Alexandria	15 0	15 0	Mauritius	22 6	23 0
Alicante	—	13 0	Marseilles	17 0	17fr.
Ancona	—	10 6	Montevideo	24 0	23 6
Aden	—	22 0	Montreal	—	—
Ascension	—	—	Messina	14 0	13 0
Athens	14 0	14 0	Muscat	—	—
Batoum	—	—	New York	—	—
Bombay	22 6	24 0	New Orleans	—	15 0
Bahia	20 0	22 0	Naples	14 6	14 0
Barbadoes	—	12 0	Nagasaki	30 0	—
Barcelona	17 0	17 0	Odessa	15 0	14 0
Beyrout	—	—	Oporto	12 6	11 0
Boston	—	—	Penang	—	—
Brindisi	—	11 0	Pernambuco	—	23 0
Buenos Ayres	—	26 6	Palermo	14 0	13 0
Bermuda	—	12 0	Panama	—	26 0
Bussorah	32 6	23 0	Para	20 0	21 0
Calcutta	—	17 0	Philadelphia	—	11 0
Callao	23 0	25 0	Port-au-Prince	—	—
Cape Good Hope	20 0	23 0	Porto Rico	—	—
Cape de Verds	—	12 6	Port Said	16 0	16 0
Cadiz	9 6	9 6	Reunion	24 0	—
Cagliari	—	12 0	Rio Grand du Sul	30 0	37 0
Carthagena	—	—	Rio Janeiro	25 0	23 0
Cardenas	—	—	Rosario	—	32 6
Cienfuegos	—	—	Seychelles	—	—
Coconada	—	—	Singapore	21 0	21 6
Civita Vecchia	15 0	14 6	Saigon	—	—
Colombo	25 0	—	Shanghae	—	—
Colon	—	10 0	San Sebastian	—	—
Constantinople	15 6	15 0	San Francisco	17 0	17 6
Corfu	—	15 0	St. Catherine's	—	—
Demerara	14 0	16 0	St. Paul de Loando	—	—
Fayal	—	—	St. Thomas	—	13 0
Fiume	—	—	St. Helena	—	—
Fernando Po	—	—	St. Jago de Cuba	—	24 6
Galle	22 0	22 0	St. Lucia	—	12 0
Guadeloupe	—	14 0	Santos	26 0	26 6
Genoa	13 0	14 0	Savona	15 0	14 0
Gibraltar	11 0	9 0	Seville	12 0	12 0
Galatz	—	14 0	Smyrna	14 0	14 0
Grand Canary	—	—	Spezzia	—	14 0
Havana	13 0	14 6	Syra	—	—
Hong Kong	—	24 0	Sierra Leone	—	20 0
Hiogo	—	—	Sebastopol	—	—
Iquique	23 0	21 6	Taganrog	—	—
Jamaica	12 0	13 6	Tarragona	—	17 6
Java	21 0	24 0	Teneriffe	—	12 0
Kertch	—	14 0	Tientsin	—	—
Lisbon	6 0	5 0	Trieste	16 0	15 0
Leghorn	15 0	11 6	Trincomalee	—	22 0
Malta	12 0	12 0	Trinidad	—	—
Malaga	—	12 6	Valencia	—	—
Madeira	—	11 0	Valparaiso	22 6	22 6
Madras	—	26 0	Venice	18 0	16 6
Manila	—	—	Yokohama	—	30 0
Maranham	—	18 0	Zanzibar	—	—

IRON EXPORTS.

Comparative exports of pig, merchant, and railway iron for the last twelve months.

Port.	1879. May.	1879. June.	1879. July.	1879. Aug.	1879. Sept.	1879. Oct.	1879. Nov.	1879. Dec.	1880. Jan.	1880. Feb.	1880. March.	1880. April.
(Pig Iron.)	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Ardrossan	1,885	196	965	2,980	1,850	5,510	2,606	555	—	4,281	10,666	6,909
Borrowstones	335	100	102	—	—	—	—	—	—	—	—	—
Cardiff	750	10	7	208	60	1,103	300	700	950	110	18	4,706
Charlestown	30	—	15	—	—	—	—	—	—	—	—	—
Glasgow	8,237	5,504	6,012	8,432	16,780	21,129	16,185	12,314	13,895	10,775	24,123	24,675
Goole	100	—	—	—	—	150	94	—	—	—	—	—
Grangemouth	10,055	1,524	2,450	2,110	2,870	3,447	1,285	320	960	1,084	3,795	3,863
Granton	—	10	30	—	9	—	10	20	—	—	110	180
Greenock	10	—	175	180	2,490	6,000	—	60	200	—	300	300
Grimsby	72	16	20	35	50	5	—	—	250	—	400	450
Hartlepools	2,414	1,540	1,109	2,221	2,118	4,140	2,765	4,696	1,120	1,869	4,090	6,587
Hull	1,711	2,601	1,769	1,618	1,478	2,871	2,191	3,295	2,158	3,707	1,332	4,704
Liverpool	1,751	1,861	2,534	2,851	10,792	21,131	17,637	11,391	54,461	19,748	21,869	26,742
Middlesborough	44,167	25,449	26,652	31,283	40,601	48,528	31,723	1,086	32,380	38,532	50,119	58,574
Newcastle-on-Tyne	5,991	2,184	4,169	4,498	5,114	7,392	7,523	3,350	9,480	3,660	5,103	7,053
Newport	45	—	110	—	—	50	1,000	—	1,550	381	2,737	—
North Shields	—	—	400	322	—	250	66	—	—	—	—	—
Port Glasgow	—	—	—	—	200	—	—	—	—	—	—	—
South Shields	85	—	—	—	70	140	510	—	6	—	—	115
Sunderland	540	180	50	—	—	—	—	—	655	970	—	175
Swansea	4	—	20	—	—	—	—	20	—	252	1,950	—
Troon	550	310	2,250	400	20	—	3,850	200	1,620	40	0,200	2,850
Whitehaven	5,145	850	4,320	1,280	3,800	700	2,190	1,200	1,100	1,050	2,748	6,037
(Merchant Iron.)												
Ardrossan	—	6	—	—	—	—	—	—	—	—	—	—
Cardiff	2,445	—	823	3,500	936	1,209	2,016	2,708	263	982	1,553	1,335
Glasgow	997	502	723	954	619	883	716	716	1,435	74	573	353
Goole	—	—	—	—	—	—	—	—	—	—	—	—
Grangemouth	—	—	—	—	—	—	—	—	—	—	—	—
Greenock	—	—	—	—	14	—	—	—	—	—	—	—
Grimsby	10	33	15	5	8	4	5	50	—	—	18	23
Hartlepools	734	765	993	42	564	632	89	517	210	94	33	171
Hull	981	804	913	1,274	1,505	2,676	3,505	1,939	1,986	1,157	983	1,235
Llanelly	—	—	—	—	450	—	—	—	—	—	—	—
Liverpool	6,182	6,790	6,117	5,950	7,611	10,179	19,640	11,114	12,111	12,046	18,215	14,013
Middlesborough	5,154	4,022	3,486	775	1,095	943	1,013	517	37	56	39	195
Newcastle-on-Tyne	4,102	1,220	1,336	1,250	1,685	1,510	1,377	3,075	231	379	678	689
Newport	—	—	32	—	—	—	321	20	—	—	—	—
North Shields	430	124	18	—	—	10	—	—	—	—	—	—
Seaham	—	—	—	—	—	—	—	—	—	—	—	—
South Shields	90	1	47	29	58	187	189	5	80	—	—	—
Stockton	—	—	—	—	—	—	—	—	—	—	—	—
Sunderland	—	11	6	—	—	545	—	—	—	20	—	1,330
Swansea	—	—	385	936	912	30	1,016	52	240	80	—	—
(Rails.)												
Ardrossan	—	—	—	—	—	—	1,000	940	—	—	275	—
Cardiff	3,427	4,532	5,851	10,174	11,380	15,192	6,007	7,643	17,005	9,503	17,139	18,663
Glasgow	—	—	503	900	1,536	—	3,504	704	640	82	—	—
Greenock	—	—	—	700	—	—	—	—	—	—	—	440
Grimsby	—	—	—	—	410	687	1,005	410	1,000	—	2,298	500
Hartlepools	50	—	—	—	—	—	—	450	—	—	50	—
Hull	37	1,285	7	0	157	827	1,315	—	1,594	351	978	1,740
Liverpool	5,621	8,420	8,912	7,440	8,402	9,116	12,580	8,050	11,730	6,654	13,067	12,541
Middlesborough	2,050	4,358	2,105	1,005	1,684	2,031	1,733	450	2,600	500	5,104	3,070
Newcastle-on-Tyne	3	4	1,171	42	—	3	—	255	—	—	20	2
Newport	5,501	4,691	10,686	5,013	8,757	3,222	4,206	5,803	7,237	6,895	8,893	—
Port Glasgow	—	—	—	—	—	—	503	—	—	—	—	—
South Shields	10	—	—	—	—	—	100	—	—	—	—	—
Sunderland	—	—	—	—	—	—	—	1,970	—	—	—	600
Swansea	10	—	—	1,344	—	735	346	—	608	—	553	1,027
Troon	—	—	—	—	480	6,000	—			—	—	—

LATEST STOCK EXCHANGE PRICES.

BRITISH MINES.

Authorised Issue.	Share	When x d or x in.	Div.	NAME.	Paid.	Closing quotations, Thursday night.	Business done. Thursday.
12,000	5		nil.	Assheton, Limited	all	⅜— ⅝	
10,240	5	27 Feb.	8/	Devon Great Consols, Limited	1	11½— 12½	
6,144	—	16 Oct. 72	2/	East Caradon. Liskeard	3.8.6	2¼— 2¾ p.m	
1,906	—	30 Oct. 74	—	East Lovell. Helston	4.0.0	—	
15,000	—	15 April	8/	Great Laxey, Limited...	all	17½— 18½	
18,000	1	30 Nov. 75	1/	Hingston Downs Consols, Limited ...	9/	¾— 1	
9,000	—	14 Jan. 76	2/	Marke Valley, Liskeard	22.9	1½— 2	
40,000	4	27 Feb.	2/	Mwyndy Iron Ore, Limited	3¼	2 — 1½ dis	
2,800	—		nil.	Prince of Wales. Calstock...	¾	—	
512	—	15 April	40	South Caradon. Liskeard	1¼	120 —130	
6,123	—	29 April	15/	South Condurrow. Camborne	6.5.6	10½— 11½	
4,500	—	1 April	15/	South Wheal Frances. Redruth	7.12.4	17 — 19	
12,000	6	29 Dec. 76	5/	Tankerville, Limited	all	4½— 5	
6,000	—	14 June 77	5/	Tin Croft. Redruth	10½	17 — 19	
15,000	4½	15 Jan.	10/	Van, Limited	all	17½— 19½	
6,000	—		nil.	West Bassett. Redruth	6.10.0	18 — 19	
3,000	—	14 Feb. 78	10/	West Chiverton. Perranzabuloe	19¾	—	
600	—		nil.	West Seton. Camborne	55.15.0	22 — 25	
512	—		nil.	Wheal Bassett. Redruth	6½	3½— 4½	
5,179	—		nil.	Wheal Grenville. Camborne	15.12.0	9 — 9½	

COLONIAL AND FOREIGN MINES.

Authorised Issue.	Share	When x d or x in.	Div.	NAME.	Paid.	Closing quotations, Thursday night.	Business done. Thursday.
35,000	2	1 April	1/	Alamillos, Limited	all	1 — 1½	
65,000 70,000	1	17 May 76	1/	Almada & Tirato Consolidated Silver Mining Limited	all	½— ¾	
12,000	5	—	nil.	Argentine, Limited	all	—	
20,000	20	31 July 78	2/	Australian	7	1¼— 1¾	
20,000	2½	—	nil.	Australian United Gold, Limited	all	—	
10,000	50	—	—	Bilbao Iron Ore, Limited	all	25 — 30	
20,000	10	17 March	17/6	Cape Copper, Limited	7	37 — 39	
13,350	10	30 Nov. 76	nil.	Chicago Silver, Limited	all	—	
62,827	2	—	nil.	Chontales Consolidated, Limited	all	1-16 —3-16	
61,000	5	12 Feb. 75	4/	Colorado United Mining, Limited... ...	all	2¼— 1¾	⅞. 2⅛
10,000	20	3 May 77	3/	Copiapo Limited	17	8½— 9	
92,915	1	12 April 72	nil.	Don Pedro, North del Rey, Limited ...	all	⅝— ¾	11-16, ⅝. ¾
27,528	10	17 Jan. 77	nil.	Eberhardt and Aurora, Limited	all	3½— 4½	3½. 4½
100,000	1	—	nil.	Exchequer Gold and Silver Mining, Lim.	all	¾— ⅞	13-16
30,000	10	31 July 73	5/	Flagstaff, Limited	all	1¼— 1½	⅜. ½
25,000	2	1 April	5/	Fortuna, Limited	all	4½— 5½	
55,000	2	13 Feb. 79	1/	Frontino and Bolivia Gold, Limited ...	all	3½— 4	
27,469	8	15 May	4/	General Mining Association, Limited ...	all	3½— 4	x d
100,000	1	—	nil.	I.X.L. Gold and Silver Mining, Limited...	all	¼— ½	⅜
20,000	5	31 July 73	2/	Last Chance Silver Mining of Utah ...	all	—	
15,000	3	1 April	8/	Linares, Limited	all	5½— 6	
105,000	2	15 July 75	1/	London and California, Limited	all	⅜— ⅝	
7,927	5	12 April 72	—	Lusitanian, Limited	4¾	—	
66,000	5	—	nil.	New Quebrada, Limited	all	3⅜— 3⅝	3⅝. ⅞
20,000	5	—	nil.	New Zealand Kapanga Gold, Limited ...	all	—	
200,000	1	—	nil.	Nouveau Monde Gold Mining	all	1⅛— 1¼	1 3-16. ⅜
50,000	4	—	nil.	Panulcillo Copper, Limited	all	3⅝— 4	4
80,000	3	—	nil.	Pestarena United Gold, Limited	all	¼— ⅜	
10,000	20	15 Dec.	10/9	Pontgibaud Silver Lead Mining & Smelting	all	19 — 21	
100,000	2	13 Feb.	1/4	Port Philip, Limited	1	½— ¾	
54,000	5	,,	7/6	Richmond Consolidated Mining Company, Limited...	all	15¾— 16¼	
1,858,880*l.*	100	2 Jan.	5 p.c.	Rio Tinto. Lim. 5 p. ct. Mort. Deb. (Spanish Coupon Bonds)	all all	94½— 95½	95½. ⅛
225,000	10	23 April	10/.	Do. Shares	all	11¼ — 11½	11⅜
100,000	1	—	nil.	Rossa Grande, Limited	all	3-16—5-16	12. ⅛
120,000	1	28 Nov.	1/6	Scottish Australian, Limited	all	1¾— 2⅛	
80,000	1	,,	/9	Do New	½	⅜— ⅝ p.m	
122,500	2	15 April	1/	Sierra Buttes Gold Mining, Limited ...	all	1⅝ — 1⅞	x d
140,025	2	,,	3/	Do. Plumas Eureka, 1872 ...	all	2⅜— 2⅝	,,
253,000*l.*	Stck.	31 Dec.	25 p.c.	St. John del Rey, Limited	100	215 —225	
68,230	10	27 June	33/	Tharsis Sulphur and Copper, Lim.... ...	all	28½— 29½	
31,000	10	,,	23/1	Do. do.	7	—	
43,174	—	—	nil.	United Mexican, Limited	29.2.8¾	2 — 2½	
10,000	10	16 Dec.	1/6	Vancouver Coal, Limited	6	2½— 1½ dis	
75,000	1	—	nil.	Yorke Peninsula, Limited	all	¼— ⅜	
40,000	1	13 July	...	Do. Preference	all	⅞ — 1⅛	1 1-16

COAL, COPPER, IRON, &c., COMPANIES.

Authorised Issue.	Share	When x d or x in.	Div.	NAME.	Paid.	Closing quotations, Thursday night.	Business done. Thursday.
6,391	100	1 April	£5	Bolckow Vaughan, Limited "A"... ...	all	133 —135	
18,609	100	,,	2.17.1	Do "A"... ...	60	17 — 20 p.m.	
27,000	10	30 March 76	nil.	Chillington Iron, Limited	all	4 — 5	
14,000	20	12 March 74	nil.	Darlington Iron Company, Limited ...	15	—	
74,475	23	30 Dec. 74	20/	Ebbw Vale Steel, Iron & Coal, Limited ...	20	10½— 11½ dis	
70,000	3	27 Feb.	1/	English and Australian Copper, Limited...	2½	1¼— 1½	
20,000	10	29 Jan. 75	nil.	Huntington Copper and Sulphur, Lim. ...	9¼	—	
2,000,000*l.*	100	3 May	6 p.c.	Lehigh & Wilkes Barre Coal 1 Mort. 6 p.c. Sterl. guar. by Cent. Rail Co. of N. J...	all	98 —100	
10,000	10	—	nil.	Lydney and Wigpool Iron Ore, Limited...	6½	8 — 7 dis	
22,000	10	1 April	—	Muntz's Metal, Limited	5½	—	
5,000	100	—	nil.	Nantyglo & Blaina Iron Works "Pref" Limited...	all	27 — 32	
50,000	3	31 July 77	2½ p.c.	Nerbudda Coal and Iron, Limited... ...	2½	2 — 1¾ dis	
—	20	—	nil.	New British Iron	17	2 — 4	
15,000	10	—	—	Newport Abercarn Black Vein Steam Coal, Limited...	all	6¼— 6¾	
12,000	20	28 Aug. 74	nil.	New Sharlston Collieries, Lim. Pref. ...	all	3½— 4½	
12,000	20	30 June 75	nil.	Pelsall Coal and Iron, Limited	17½	— dis	
10,000	50	12 March 75	nil.	Rhymney Iron, Limited	all	24 — 25	
10,000	15	,,	nil.	Do. New	all	6½—	
105,330*l.*	100	—	—	Do. 7 p.c. Deb., Regist. 1890 ...	all	—	
		—	—	Do. 7 p.c. to Bearer, 1890.... ...	all	—	
24,600	25	15 Dec.	10/	West Cumberland Iron and Steel, Lim...	20	7 — 5 dis	

NEW COMPANIES.

"ALERT" STEAMSHIP.—Incorporated 7th inst., as an unlimited company, with a capital of £17,280 in 64 shares of £270 each, for the purpose of acquiring and working the *Alert* and other steamships.

BRITISH AND SCANDINAVIAN STEAM SHIPPING.—Registered with a capital of £100,000, in £10 shares, on the 6th inst., to carry on the ordinary business of a steamship company.

CIRENCESTER IMPROVED DWELLINGS.—The erection of improved dwellings in the town and neighbourhood of Cirencester is proposed by this company. It was registered 5th inst., with a capital of £5000 in £10 shares.

DARE TIN PLATE WORKS.—Upon terms of an agreement of 1st of March, this company proposes to acquire the Gad y's Uchaf Foundry, situate in the parish of Aberdare, Glamorgan. It was registered 10th inst., with a capital of £100,000 in £10 shares, for the purpose of carrying on the business of carrying on the business of tin-plate manufacturers. The purchase consideration is £35,000, of which £12,500 is payable in fully paid up shares.

HARRISON'S PATENT GAS LIGHT IMPROVER.—The object of this company is to acquire interest in the patented inventions of Frederick James Harrison, relating to improved attachments to fish tail and other gas burners, for expanding and improving the light from the same, and to carry on the business of gas engineers. It was registered 10th inst., wite a ca ital of £2000 in £20 shares.

PATENT DRY AIR REFRIGERATING.—Upon terms of an agreement of the 6th inst., this company proposes to purchase and work the letters patent, dated 1st May, 1879, granted to Mr. Kennard Knott, of 283, Strand, for improvements in dry air refrigerating apparatus. It was registered 8th inst., with a capital of £5000, in £10 shares. The purchase consideration is £40 and one-half of the surplus net profits remaining after payment of 10 per cent. per annum on the ordinary share capital.

PATENT KILN.—This company proposes to acquire and work patents and patent rights, both British and foreign. It was registered 7th inst., with a capital of £4000 in £1 shares.

PATENTS' DEVELOPMENT.—This company proposes to acquire, work and extend patents and patent rights. It was registered 10th inst., with a capital of £20,000, in £5 shares.

PEERLESS SHIPPING.—Registered 7th inst., with a capital of £1000 in 10 shares of £100, to carry on the business of shipowners, with power to purchase any existing business.

REDRUTH MINING EXCHANGE.—This company was registered 7th inst., with a capital of £500 in £5 shares, to acquire houses and buildings for the purpose of holding meetings for the buying and selling of stocks and shares of mines and other properties.

WESTON COYNEY AND CINDERHILL COAL AND BRICK.—On the 8th inst. this company was registered with a capital of £30,000 in £5 shares, to purchase and work the Weston Coyney and Cinderhill Collieries and Brick Works, situate near Longton, Stafford.

WHEAL FORTUNE WORKS.—Registered 7th inst., with a capital of £5000 in £1 shares, to carry on the business of miners, smelters, metallurgists, and manufacturers, and dealers in chemical products.

PARTNERSHIPS DISSOLVED.

Bill and Deacon, Maidenhead, Berks, proprietors of the steam launch *Undine*.—J. Preston and Sons, Birmingham, boiler makers.—W. Hutton and Sons, Sheffield, and Thavies-inn, Holborn, manufacturers of silver and plated goods; as far as regards R. Hutton.—J. Perry and H. Harrison, Birmingham, jewellers.—A. Botton and W. H. Bulpitt, Birmingham, engineers.

SOUTH WALES COAL SHIPMENTS, APRIL, 1880.

SUMMARY of foreign coal shipments from Cardiff, Newport, Swansea and Llanelly, during the month of April, 1880:—

	Tons.		Tons.
Aden..	14,494	Leghorn	3,461
Alexandria	6,388	Lisbon	10,240
Algiers	1,079	Madeira	1,913
Alicante	5,049	Malta	23,976
Amsterdam	1,958	Marseilles	9,774
Ancona	2,080	Martinique	4,162
Anjer	1,985	Mataro	300
Antwerp	1,400	Madras	32
Bahia	2,537	Mauritius	357
Barbadoes	836	Messina	800
Barcelona	12,249	Monte Video ..	9,839
Bayonne	1,059	Naples	3,917
Bergen	720	Nantes	10,691
Bilbao	2,520	Odessa	14,823
Bombay	21,441	Oporto	1,966
Bordeaux	14,845	Palermo	2,564
Brest..	1,458	Patras	580
Brindisi	1,020	Pernambuco ..	737
Buenos Ayres ..	3,723	Port Said	34,897
Cadiz	5,247	Rangoon	6,199
Caen	10,616	Riga..	2,965
Caldera	460	Rio de Janeiro ..	10,879
Calcutta	1,361	Rio Grande do Sul..	787
Callao	2,316	Rochfort	7,874
Cape de Verds ..	11,868	Rouen	1,3921
Cape Town	9,314	Santander	1,440
Carloforte	2,305	Santiago	560
Carthagena	1,797	Santos	978
Charente	190	Savona	6,226
Christiania	346	Seville	1,903
Constantinople ..	16,974	Singapore	23,384
Copenhagen	2,114	Smyrna	4,068
Coquimbo	404	St. Thomas	803
Cronstadt	3,693	Stettin	1,912
Demerara	499	Stockholm	2,888
Dieppe	13,683	St. Malo	10,094
Fayal	2,533	St. Nazaire	32,499
Fecamp	1,195	Swinemunde ..	730
Galatz and Danube..	1,150	Syra..	1,819
Genoa	16,877	Tarragona	381
Gibraltar	22,217	Teneriffe	2,247
Guadaloupe	2,186	Trieste	6,203
Hamburg	695	Trouville	2,119
Havre	18,687	Valencia	440
Hong Kong.. ..	9,048	Valparaiso	10,128
Jamaica	376	Venice	1,625
Java	2,962	Vigo	172
La Rochelle.. ..	5,832		

SOUTH WALES IRON SHIPMENTS.

APRIL, 1880.

SUMMARY of foreign shipments of Iron from Cardiff, Newport, Swansea and Llanelly during the month of April, 1880:—

	Tons.		Tons.
Alexandria...	25	Brought up ...	10,774
Amsterdam	215	Lisbon	10
Baltimore	1,585	Madras	1,457
Bilbao	414	Natal	3,170
Bombay	3,176	Newcastle, N. S. W. ...	1,609
Buenaventura	487	Newhaven, U. S... ...	579
Cagliari	329	New Orleans	1,065
Callao	144	New York	18,205
Carloforte	31	Oporto	187
Friguea	629	P. E. Island	19
Galveston	1,501	Pensacola	1,700
Greytown	204	Philadelphia	7,642
Guadaloupe	20	Portland	1,567
Henlon	97	Porto Torres	150
Huddickwall	257	Quebec	906
Kurrachee	1,570	St. Stephen's	2,686
Carried up ...	10,774	Total	50,976

SCOTCH PIG-IRON.

ANNEXED is a weekly statement of the shipments during this and the previous three years:—

Week end.	1880 Tons	1879 Tons	1878 Tons	1877 Tons
Jan. 3 ..	6677	4655	2441	3454
10 ..	6689	6069	6085	6500
17 ..	12,288	6291	4532	5141
24 ..	7566	6331	6170	7040
31 ..	13,383	4969	6550	5297
Feb. 7 ..	14,190	6130	5637	6183
14 ..	10,612	7272	5722	5839
21 ..	15,152	8996	5124	6559
28 ..	12,603	8318	7836	8630
March 6 ..	17,968	13,910	6816	8048
,, 13 ..	20,985	10,743	8662	7280
,, 20 ..	20,987	11,167	7725	9312
,, 27 ..	23,598	9,463	11,499	10,246
April 3..	15,722	12,653	7448	9071
,, 10 ..	18,309	12,913	9441	10,721
,, 17 ..	15,784	13,228	9513	10,020
,, 24 ..	16,279	11,795	8,382	13,390
May 1 ..	17,749	12,923	8,853	11,915
,, 15..	13,123	9,919	7,820	11,547
Total ..	297,563	190,880	145,604	166,875

BRITISH IRON EXPORTS.—A return has been compiled from Custom House sources showing the extent of the exports of iron from the various ports of the kingdom for the month of April. It appears from this that Middlesborough stood at the head, exporting 58,274 tons of pig-iron, Liverpool taking second rank with 25,378 tons, and Glasgow following with 23,575 tons; Newcastle-on-Tyne exported 7053 tons; Ardrossan comes next with 6909 tons of pig-iron; and West Hartlepool, exporting 6578 tons, is closely followed by Whitehaven with 6037 tons. Cardiff exported 4706 tons, and Hull 4704; Grangemouth, 3858 tons; Troon, 2850; and Newport, 1254 tons. Of bar iron and of rails the largest quantities were exported from Liverpool, Newport, Cardiff and Middlesborough in the order named, he quantity sent from other ports being very small.

DIARY OF FORTHCOMING SALES.

NOTICES OF SALES OF ENGINES, PLANT, AND MACHINERY, IMPLEMENTS, MINES AND COLLIERIES.

For Particulars of entries see Advertisements at end of Paper.

PLACES OF SALE.	PROPERTY FOR SALE.
On Great Northern.	Engineering Business.
Wrexham.	Broughton Hall Iron Works.
Liverpool.	Hand Leather, &c.
Liverpool.	Foundry.
London.	Millwall Ironworks.
Cardiff.	Bute Ironworks.

OPEN CONTRACTS.

Pontypridd.	Girders and Ironwork.
London.	Iron Bridge Work.
Bristol	Gas Coals.

PRICES CURRENT OF MANUFACTURED GOODS OF BIRMINGHAM AND DISTRICT.

⁂ This List being compiled exclusively for the pages of IRON, all rights of reproduction are reserved.

The quotations given are merchants' and factors' average prices, dependent, of course, on terms of payment as well as the quality and quantity of goods ordered, and fluctuations in cost of raw material.

The Prices and Discounts quoted are carefully revised every week, and great pains are taken to render this List thoroughly reliable.

May 20th, 1880.

The hardware market, although drooping and fully sympathetic in heavy ware with the iron market, shows no great change in the week, and considering the great reaction which has set in in iron and the great fall in prices, which has occurred the last two months, it is rather surprising that hardware has not been affected more and that shelf goods have not undergone more change; as it is, the heavy branches have shown the greatest fluctuations Last week we noticed that one or two of the Warrington makers were offering from 30s. to 40s. off list prices of wire. This is the case, but as yet the different wire houses have not sent out their list officially, but we presume they will do, so as the isolated action of one or two makers offering such a large reduction must speedily become known generally and be followed at once by others. The fact, we believe, is that there is no regular list just now and prices are not settled enough to tempt buyers, although the contract list is getting larger day by day, as if the opinion was gaining ground that prices have nearly reached bottom. Last week we notified a reduction on curry combs, shoe heels, iron wire, and gas tubes. This week plate locks have been increased in discount 2½ per cent., and frying pans, and other wrought iron goods, such as basins, pudding pans, cash bowls, strong hammered and wired water bowls have all been reduced, the discounts being increased 2½ per cent., equal to between 72 and 10 per cent in the net. Solid drawn brass tubes are reduced in price ½d. per lb., but no further alteration is at present made in brass or copper wire or sheets, notwithstanding the late great fall in copper.

ABRIDGED LIST.

Axles, 15 to 25%; coach ironwork, 10 to 15%; coach and waggon springs, 15 to 20%; Augers, 10 to 20%. **Axes**.—Ship carpenters', /5½ to /6 per lb.; Kent and house carpenters', /5 to /6; ditto, steel polished, /5½ to /7; felling axes, /4¼ to /4¾; polished, /4½ to /6; bright and blued solid steel, /7 to /8; American felling or wedge Axes, steel polished, 1/ to 1/4 per lb.; common **Anvils**, 84 lb. and upwards, 18/6 to 20/ per cwt.; best warranted, 22/ to 24/; ditto, and ends warranted not to break off, 27/ to 35/.

Basins, shallow galvanised, 10 inch, 7/ to 7/6 per doz.; deep Basins, galvanised, 12 inch, 10/6 to 12/6 per doz.; Bastard **Bellows**, 42½ to 50%; Best extra nailed Bastard, 37½ to 45%; Best improved long Bristol, 35 to 40%; casters' or moulders', best extra nailed, 12 inch, 30/ per doz. net; common **Smiths' Bellows**, 45 to 50%; Best warranted, extra leather doublenailed, 36 to 40%; with movable pipe for shipment 2½% less discount. **Bed screws**, 6 and 7-16 and ⅜ inch, 10/6 to 11/6 per gross for London black heads; London heads with bright turned collar, 6 and 7-16 and ⅜ inch nuts, 12/9 to 13/9; Black welded heads, 9/3 to 10/3; common slit heads, 6 and ⅜ and ¼ inch, 9/3 to 10/3; Bright turned notched heads, 6 and 7-16 and ⅜ inch, 12/9 to 13/9; black notched heads, 10/6 to 11/6 per gross; **Brass head nails**, 40 to 42½%; star head, 35 to 40%; Brass plated countersunk head, 25 to 30%; **Blacksmiths' tongs**, 26/ to 28/ per cwt.; real fine wrought **Box irons**, 20 to 25%; fine cast, 42½ to 60%; middle cast, 42½ to 60%; charcoal box irons—Victoria, 45 to 50%; ordinary charcoal box irons, 55 to 70%; **Bolts**—Straight tower; solid end tower, 65 to 67½%; end Best solid tower, 60 to 65½%; solid end barrel brass knob, 60 to 62½%; japanned Scotch tower bolts, 45 to 50%; painters' brushes, 45 to 65%; Best, 10 to 40%; light galvanised **Buckets**, 12 inch, 38 lb. to the doz., 10/ per doz. net; **Blind cord**, list price net; **Bed hooks and eyes**, 50 to 55% malleable, 62½ to 67½%; Brass chain **Beading**, 30 to 35%; Brass and plate coach beading, 30 to 35%; ashpan moulding, 20 to 30%; **Bottle jacks**—Linwood's, 15 to 20%; Salter's, 30 to 35%; Nicholas's, 15 to 20%; common painted **Beams**, 35% to 65%; Bright round end beams, 40% to 55%; Bright box end beams, 40 to 55%; deep **Copper scales**, 45 to 65%; **Steelyards**, 40 to 60%; pocket steelyards, best counter weighing machines, Avery or other best make, 25 to 30%; common, with round copper scale, 7 lb., 3/ to 5/; 14 lb., 3/9 to 5/9; 28 lb., 5/ to 8/ each, net; **Bedsteads**, cheap stump, 6 feet by 3 feet 6 in., 7/6 to 9/6 each; cheap French, 6 feet by 3 feet 6 inches, 8/6 to 10/6 each, rising /6 for every 6 inches. **Brass**—Rolled brass, 2 to 12 inches wide, to 30 W.G., /8¼ to /9½ per lb.; Brass sheets, 24 by 48 in., 8 lb. and upwards or 27 W.G., /8¾ to /9½ per lb.; **House bells**, brass rough, /10 to 1/1 per lb.; turned edge, /11¼ to 1/1; turned, and lacquered on edge, 1/8 to 2/ per lb.; cattle and sheep bells, with brass loops, 1/3½ to 1/6 per lb.; clock bells, 1/9 to 1/10; ship and turret bells best, 1/4 to 1/5 **Battery kettles**, 150/ per cwt.; composition sheathing and **Slating nails**, /10 to /10½ per lb.; Brass **Escutcheon pins**, ⅜ by 16 inch, W.G., /10 to /10½. **Brass jelly pans**, with bails, /10½ to /11; without bails, /11½ to 1/ per lb. **Maslin kettles**, cast, 4 to 16 inch, /10 to /11 per lb. **Pinpoints**, 1/3 to 1/4. Brass **Rivets** for boots, 12 to 17, W.G., /9½ to /10 per lb. Brass **Shoe Bills**, 1/1 to 1/2 per lb. Brass **Scale pans**, 1/10 to 1/11; Brass **Toddy kettles**, 15 to 20%. Brass **Tubes**, plain rough, ⅜ inch and above, /9¾ to /10 per lb. Locomotive and marine boiler tubes, seamless from 1¼ to 4 inch outside diameter, to 14, W.G., /8 to /9.

Copper.—**Copper boat nails**, wrought 1½ by 12 inch, W.G., and upwards, /10½ to 1/1 per lb. Copper 1 boat **Roves**, ½ inch and upwards 1/2½ to 1/3 per lb. Copper **Brads and bills**, same price as tacks. Light round Copper **Kettles**, bare rivets, 1/11½ to 2/ per lb. Light round covered rivets, 1/10 to 1/11½; loaded, 1/8 to 1/9; oval Copper kettles, bare rivets, 2/3 to 2/4 per lb.; oval bare rivets raisedown, 2/5 to 2/6 per lb. Copper **Rivets** and washers, 1/ to 1/1 per lb.; Copper **Slating nails**, cut, 1 to 1½ inch and upwards, /11½ to 1/ per lb.; Copper **Scale pans**, 1/11 to 2/2 per lb.; cut Copper **Nails and tacks**, 1 inch and upwards, 1/ to 1/1 per lb.; wrought Copper nails and tack, 1/4 to 1/5 per lb.; Copper **Wire**, 0 to 20 W.G., /10¼ to /11. **Brass cupboard turns**, 45 to 52½%; **Chair webbing**, No. 9, 4/5; 10, 4/8; C9, 4/1; C10, 4/6 per gross of 66 yards; **Carpet rings** 1/ to 1/6 per gross; **Cornice poles**, 2¾ inch, brass best burnished 4/6 per foot, 25 to 35%, 3/4 covered; brass poles, 1/2 per foot, 25 to 35, imitation mahogany cornice poles with ends and rings complete, 2¾ inch, 1/ per foot; light birch ditto, 1/1 to 1/2 per foot; real mahogany, 2/1 to 2/6 per foot; cornice pole rings, brass, 2¾ inch, light, 2/9; middle, 3/7; strong, 4/2 per doz., 20 to 30%; wood cornice pole rings, 2¾ inch, imitation mahogany, 16/ to 18/ per gross net; light birch, 17/ to 19/; real mahogany, 22/ to 25/ per gross net; machine made wire **Chain**, single link, iron, 42½ to 47½%; double link, iron, 37½ to 47½%; single link, brass, 37½ to 47½%; registered double link, brass, 32½ to 37½%; close link brass Chain, 5 to 10% brass oval lamp Chain, 22½ to 27½%; brass Clock Chain, 22½ to 27½%; japanned pillar Chains, 1 yard, 16 by 6, 6/8 to 7/6 per doz.; japanned manger, 1½ yard 16 by 6, 8/3 to 9/6; japanned rack, 1 yard, 18 by 6, 5/6 to 6/6, japanned dog, 1½ yards, 12 by 7, 6/6 to 7/6; 2 yards, 14 by 6, 11/ to 12/. **Cowties**, a chain, or Derbyshire, 8/ to 10/; open ring, 8/ to 10/; close ring, 7/ to 8/ per doz.; japanned watering chains, 14 by 6, 4/9 to 5/9; tinned watering chains, 5/ to 6/; bullock chains, ⅜ inch hook at each end, 17/ to 18/ backbands, 17/6 to 18/6; short link Chain, plain or twisted, ⅜ inch, 17/ to 18/; ½ inch, 15/ to 16/; 1 inch, 14 to 16/ per cwt.; Cart and plough traces, 20/ to 21/ per cwt. **Chesthandles**, improved japanned, 75 to 77½%; broad plate, strong and extra strong, 15 to 55%, according to strength; railway **Cotterpins**, 55 to 60%; Brass **Curtain rings**, 45 to 50%; Brass **Chair nails**, 40 to 45%; square box **Coffee mills**, 25 to 50%; Common post Coffee mills, 20 to 30%; best brass bushed mills, 40 to 45%; London mills, 35 to 40%; registered **Coffin furniture**, 45%; Common, 70%.

Door springs, X, 75 to 80%; XX, 70 to 72½%; XXX, 65 to 67½%; XXXX, 55 to 60%; brass circular and iron circular, 55 to 60%; brass reliance, 10 to 15%; climax, 5 to 10%; universal, 50 to 60%; paragon, 10 to 15%; smiths', 10 to 15%; O'Connor's patent lever hinge springs, 10 to 15%; O'Connor's vertical spring hinge door spring, 15 to 25%; Gerish's spring hinges, iron, 20 to 25%; brass, 10 to 15%; japanned **Door chains**, 30 to 60%.

Files, 25 to 50%; **Frying pans**, best, 50 to 55% common, 60 to 65%; kitchen **Fireirons**, in sets, /6 to /7 per lb.; tongs only, /6½ to /7; pokers only, /5¾ to /6 per lb. **Fish hooks**, 30 to 35%, best; common, 50 to 55%; light kitchen **Fenders**, 5 inch assorted, 2 feet 6 inches to 3 feet 6 inches, black fronts, 28/ to 29/ per doz.; bright fronts, 31/6 to 34/; Manchester pattern kitchen Fenders, 5 feet 1 inch top, black front, 2 feet 9 inches to 3 feet 3 inches, 37/6 to 41/ per doz.; 3 feet 3 inches to 3 feet 9 inches, 42/6 to 46/. Cut wire **Fencing staples**, 0 to 6, 22/ to 24/ per cwt.

Gridirons, London pattern, fluted, 62½ to 65%; light ditto, 61½ to 67½%; hanging round bar, 50% to 55%; doublet, 37½ to 42½%; round bar /1½ per bar, 57½ to 62½%; best fluted bar, 5½ to 62½%; flat bar, 57½ to 62½%; common flat bar, 57½ to 62½%; common Gridirons, /1, /1½ and /2 per bar, 65 to 70%; **Goffering tongs**, two prongs, 5/6 to 6/6 per doz.; **Gimblets**, 10 to 15%.

Holdfasts, japanned, 20/ to 21/ per cwt. **Hammers**, platelayers' keying, 33/ to 35/; miners', 27/6 to 28/6; sledge, 27/6 to 28/6; stone sledge, 27/6 to 28/6; stone, hand, 28/6 to 30/6; stonemasons' hand, 2 to 6 lb., 28/6 to 30/6; pin maul, 2 to 6 lb., 35/ to 37/ per cwt.; sledge hammers, 6 lb. and upwards, 28/6 to 30/6 per cwt.; riveting hand-hammers, 28/6 to 30/6; miners, not steeled, 22/ to 24/ per cwt.; common Kent hand hammers, 20 to 50%; patent hasps and staples, 20 to 25%. **Cast hinges**, polished joint light patent tariff butts, 200, 45 to 50%; 333, 47½ to 47½%; 564, 35 to 40%; polished joint, best best butts, best best, 45 to 50% ditto light tariff, broad butts, 45 to 50%; best heavy, broad butts, 30 to 35%; **Patent Hinges**, edge butts, light, 60 to 62½%; strong, 40 to 50%; patent Scotch butts, 52½ to 55%; same off broad and narrow. Patent table, bed and back-flap hinges, 50 to 52½%; extra strong bed hinges, 42½ to 55%; patent chest, 45 to 47½%; patent strap, 45 to 55%. H Hinges, 40 to 55%; HL hinges, 40 to 55%; japanned and garnett hinges, double washered, light and strong, 35 to 40%; best best patent London or Lancashire tees, 52½ to 60%; patent light japanned Scotch Tees, 55 to 62½%; light patent hooks and hinges on plate and to drive, 20 to 25%; weighty patent hooks and hinges, weighty Gothic, 21/ to 26/; scolloped edges, not japanned, 22/ to 24/; Scotch japanned, Tees double washered, 20/6 to 23/6; Gothic Scotch japanned, Tees 23/ to 28/; Gothic Scotch, Tees self colour, 17/6 to 25/. **Wrought hinges**, common and best, 35 to 40%; best best, 30 to 35%; heavy wrought hinges, common black, 14/ to 16/ per cwt.; common, bright, 16/ to 18/; filed edges, 17/ to 19/; japanned Gothic fancy, 16/ to 20/ per cwt. common bright, broad eye, 19/ to 22/; japanned broad eye fancy, 21 to 22/; best bright, 22/ to 24/; best broad eye, 23/ to 25/; best self-colour frog hooks 25/ to 26/ per cwt.; **Lancashire hinges** wrought, 30 to 35%; **Pressed hinges**, common, 62½ to 65%; best, 52½ to 57½%; common brass butt hinges, 1½ inch sanded, 15/ to 18/ per gross, pairs net; very light, 1½ inch, 9/6 to 12/ per gross, pairs net **horseshoes**, fullered fore, 18/ to 20/; fullered hind, 19/ to 21/; stamped, fore, 18/6 to 20/6; hind, 18/6 to 20/6. **Hollow ware**, 40 to 45%; common to best, enamelled, 15 to 20%, delivered in Liverpool, London.

Ironfoundry, general.—Ash grates, 11/ to 12/, air bricks, 2/9 to 3/6, half, single, 3/6 to 4/3, double, 6/3 to 7/; bars and bearers, 9/6 to 10/6 per cwt.; barrow wheels, 10/6 to 11/6; bake pans, 9/6 to 10/6; cart bushes, 11/6 to 13/6; camp ovens, 10/ to 11/; cooking stoves, 12/6 to 13/6; cogs for blocks, 17/ to 19/; cellar grating, 10/6 to 12/6; clock weights, 9/ to 11/; Dutch stoves, 11/ to 13/; dumb bells, common, 9/ to 11/; best best japanned, 19/ to 21/; frying pans, cast handles, 12/6 to 14/6; frying pans with wrought handles, 16/ to 18/; furnaces, up to fifty gallons, /3½ to /4; galvanised furnaces up to fifty gallons, /9 to 1/ per gallon; furnace doors, 12/ to 14/; furnace grates, 9/6 to 11/6; forge backs, 12/6 to 13/6; heaters for box irons, 8/6 to 10/6; heaters for urns, 10/ to 11/; jack wheels, 18/ to 20/; oven doors and frames, 12/ to 14/; pots, three legged, Danish, plumbers', and Nego, 10/ to 12/; plumb bobs, 13/6 to 15/6; pudding pans, 13/6 to 15/; pump spouts, 14/ to 16/; sash weights, 8/6 to 9/6 ditto, with pulleys, 11/ to 13/; shoe anvils, 11/6 to 12/6; slippers 12/6 to 13/6; **Italian irons**, 35 to 50%.

Knitting pins, iron, /4½ to /5 per lb.; steel knitting pins, 15 to 24 W.G., 1/ to 2/6 per lb.; brass knitting pins, 1/4 to 1/6 per lb.; **keys and banks**, 50 to 55%; extra strong plate, 30 to 32½%; extra strong Banbury, pin'd keys, 30 to 35%; brass shutter **knobs**, 55 to 60%; brass cupboard turns, 55 to 60%; brass drawer knobs, 53 to 60%; brass ash pan knobs, 55 to 60%; brass range knobs, 40 to 45%; **kettle ears**, 77½% to 80.

Lock furniture, brass, 60 to 65%; buffalo, 25 to 30%; china lock furniture, 37½ to 42½%; ebony lock furniture, 2¼-inch, Wilkes' spindles, 15/ to 18/ per dozen sets; sham ditto, 8/ to 9/ per dozen sets; **Norfolk latches**, common, best, 65 to 77½% common. **Suffolk latches**, 70 to 72½%; best Suffolk latches, 45 to 55%; tinned struck **ladle bowls**, 4-inch, 15/6 to 16/6; 4½-inch, 18/6 to 20/; 5-inch 23/ to 25/ per gross net.

Oddwork, tinned and black, 20 to 25%, list; **Paris pointes** best English, 15/6 to 16/; foreign, 18/ to 20/; **planes**, 25 to 30%; iron **axle pulleys**, 1¾ inch, 12/6 to 18/; brass face axle pulleys, 28/ to 40/ per gross; B. F. and wheel, 48/ to 60/ per gross; brass escutcheon **pins**, ⅜ inch to 16 W. G., 1/ to 1/2 per lb.; bright gimp pins, ⅜ to 19 W. G., /6 to /8 per lb.; black, /7 to /9; brass 1/6 to 1/8 per lb. Japanned cut **gimp pins**, ⅜ inch, /7 to /8 per lb.; tinned, /8 to /9 per lb.; cut clog or coffin pins, japanned, ⅜ inch, /5 to /6; tinned, /7 to /8; brass pin pointes, 1/4 to 1/6; **plate locks**, fine 50 to 52½%; strong, 40 to 42½%; Lancashire plate locks, 25 to 30%; pewter measures, 30 to 35%.

Riddles, 30 to 35%; **Rivets**, iron boot rivets, /3½ to /4 per lb. patent machine-made Rivets, 30 to 35%; wrought tinmen's Rivets, 50 to 55%; round or panhead boiler Rivets, ¼ inch, 23/ to 24/; ⅜ inch, 18/ to 19/; ½ inch, 17/ to 18/; ¾ inch, 16/ to 17/. Delivered in London or Liverpool; machine-made wire Rivets, ¼ inch, 14/6 to 15/6 per cwt. **Rakes**, light garden Rakes 50 to 60%; light solid end Rakes, 47½ to 50%; bolstered teeth garden Rakes, 50%; solid end bolstered teeth garden Rakes, 40 to 45%.

Spades and Shovels, common, 52½ to 55%; second, 35 to 40%; best 30 to 35%; best strong country Shovels; 25 to 30%; best hammered Spades and Shovels, 5 to 10%; **Ship Scrapers**, black steel blades, 45 to 50%; bright, 42½ to 47½%; cast-steel black, 42½ to 47½%; bright, 37½ to 42½%; best cast-steel black, 35 to 40%; bright, 30 to 35%; iron **Wood Screws**, 65%; brass wood Screws, 60 to 62½%; copper, 35 to 45%; Stove Screws, 50 to 57½%; dowel Screws, 60 to 65%; brass headlock Screws, 40 to 47%; gilt, silvered and plated head Screws, 40 to 45%; jute **Sash cord**, 52½ to 57½%; flax Sash-cord, 25 to 30%; best flax, 5 to 10%; super flax, 7½ to 12½%; extra super flax Sash-cord, 5 to 10%; patent steel ribbon **Sash-line**, 25 to 35%; copper **Sash-chain**, 52½ to 57½%; zinc Sash-chain, 47½ to 52½%; iron prepared, 40 to 45%; copper Sash-cord, 15 to 20%. **Sad irons**, common, 10/6 to 12 per cwt.; best japanned, 14/6 to 16/6; best best japanned, 18/ to 20/ per cwt.; **Shoe heels**, York, No. 1, 3/5 to 3/8; No. 2, 4/ to 4/3; No. 3, 8/ to 8/9 per gross net; Dundee hot turned, 5/9 to 6/3; bright-edge imperial or solid Scotch, 9/6 to 10/; bright York 61 B, 8/ to 8/6; bright solid, 6/6 to 7/; toe plates, 9/6 to 10/ per gross. **Stair rods**, turned ends, 75 to 80%; solid fancy ends, 60 to 65%; cased tube, 30 to 35%; patent solid ornamental, 35 to 40%. **Sofa Springs**, coppered, 8 by 6 inches, 25/ to 27/ per gross; 9 by 7 in., 21/6 to 23/6; 7 by 7 inches, 17/6 to 19/6 per gross; galvanised **Waterloo Scoops and hods**, 17/6 per doz.; japanned Waterloo scoops and hods, 16 inch. 15/ to 16/; japanned scoops and hods, light, 16 inch, 15 to 16/ per doz.; **Shutter bars**, common spring, broad and double, 75 to 77½%; Scotch iron drop, 77½ to 80%; brass drop, 70 to 72½%; brass drop and catch, 67½ to 70%; registered brass spring box shutter bars, 52½ to 67½%; double-handed brass spring box, 57½ to 65%; **Saddlers' tools**, 5 to 10%; **Stocks and Dies** for smiths' use, 35 to 40%; ditto for engineers, 10 to 20%; **Steel toys**, 10 to 30%.

Traps, bow spring, sham Dorset and real Dorset rabbit traps, 45 to 65%, list prices; common traps, 4 inch, 5/6 to 8/ per doz. net; run traps, 2½ inch, 4/ to 8/6 per doz.; bird traps, 3/9 to 4/ per doz.; wolf and other double flat spring, common bridge, 1/; axle bridge, 1/4 per lb., 40 to 45%; hawk or pole traps, 54 to 50%; wrought mole traps, japanned, 2/6 to 3/9; galvanised, 3/9 to 4/9. **Tin plates**, I C, 30/ to 32/. **Tinmen's machines** and tools, 5%; brass **Bell Tube**, ⅜ inch and upwards, 1/ to 1/1 per lb.; copper bell Tube, 1/2 to 1/4 per lb.; zinc bell Tube, 45 to 50% list; **Patent cased Tube**, 45 to 50%; cut to lengths, 40 to 45%; burnished and lacquered brass tube, 30 to 35%; polished and lacquered twisted brass tube, 30 to 35%; patent taper iron tube, 30 to 35%; patent cased taper iron tube, 30 to 35%; parallel iron brased tube, 30 to 35%; twisted iron parallel tube, 30 to 35%; patent cased twisted iron parallel tube, 30 to 35%; iron **Gas Tubes**, 70 to 72½%; fittings, 72½ to 75%; iron **Water Tubes**, 60 to 65%; fittings, 62½ to 67½%; iron **Steam Tubes**, 52½ to 55%; fittings, 55 to 57½%; galvanised iron gas Tubes, 57½ to 60%; fittings, 60 to 65%; lap-welded **Boiler Tubes**, 60 to 62½%, delivered in London, Liverpool or Glasgow; table catches, 36 to 40%; ditto, improved brass follow, 20 to 25%; wrought japanned **Tea kettles**, 50 to 60%; galvanised **Turnip skips**, 21 inches, light, 25 to 26/ per doz.

Vices, common black, 32/ to 34/ per cwt.; common bright, 40/ to 42/ per cwt.; black staples vices, solid box black, 42 to 48/; bright, 41/ to 47/; solid box, black staple, with spherical washer, 40/ to 45/; bright 51/ to 55/.

Washers, light iron, 72½%; heavy washers, 13 to 16 lb., W.G., 12/ to 12/6 per cwt.; ¼ inch thick, 2/ per cwt. extra; 5-16 inch, 3/; ⅜ inch 4/; shook bright washers, 3/ to 3/6 per cwt. extra; **Wall hooks**, 23/ to 25/ per cwt.; **Washing tubs**, galvansed oval, 22 inch, 29/ to 30/; 24 inch, 34/ to 35/; round, 22 inch, 38/ to 40/; **Water bowls**, hammered, list price, 50 to 62½%; light seamed 9 inch, 8/ per dozen; light wired 9 inch, stamped, 11/ to 12/; **Wove wire** list price, iron, copper and brass, 45 to 50%; iron **Wire**, bright, 0 to 6, 13/ to 14/ per cwt.; galvanised, 17/ to 18/6; fine galvanised iron wire, No. 23, 5/3 to 5/6 per stone 14 lb.; annealed tinned wire No. 18, 4/ to 4/3 per stone 14 lb.; cut tinned bottling wire, No. 22, 4/11 to 5/6 per stone 14 lb.; weaving and binding wire, No. 23, 4/ to 4/2 per stone 14 lb.; bright or annealed fine wire, 23, 5/7 to 5/9 per stone 14 lb. net; cast steel wire, 0 to 6, /9½ per lb.; 10 to 20%; metallic or horticultural wire, 6 to 14, /5½ to /6½ per lb; No. 15, 5¾ to /6; 16 to 20, /5½ to /6½; in 1 lb. rings, 1½ inch diameter, /½ per lb. extra; prepared bright **fencing Wire**, 0 to 6, 13/ to 13/6 per cwt.; annealed drawn fencing wire, 0 to 6, 11/9 to 12/3; annealed drawn galvanised, 0 to 6, 16/ to 17/. Bright or annealed steel, 0 to 6, round or oval 15/3 to 16/3 per cwt.; black rolled, 1 to 4, 10/ to 11/ per cwt.; galvanised rolled, 1 to 4, 13/3 to 14/3 per cwt.

BUSINESS CARDS.

PULFORD'S MAGNETIC PAINT.

MANUFACTURED FROM IRON,

Ready for the brush in cans, 7 lb., 14 lb. 28 lb., 36s. per cwt.—all colours. The can forms a paint pot with handle, no extra charge. Most suitable for Gas Holders, Iron Bridges, Railway Waggons, &c., and for all IRON, WOOD AND STONE WORK.

A Sample Can at Depot, 7 lb., 3s. 6d.

77, CANNON STREET, CITY E.C.,

Between Cannon Street, and Mansion House Stations, Most suitable for all Garden purposes. Established 1858.

ASBESTOS

FINE SPUN YARN AND PLAITED ROPE AS SUPPLIED TO THE ADMIRALTY FOR STEAM PACKING.

MILLBOARD, IN SHEETS,

Or Cut to Shape for Steam Joints,

AND FOR GAS ENGINES,

Bell's Patent Asbestos Boiler and Pipe Covering for Preventing the Radiation of Heat.

All Asbestos Goods of the best quality manufactured by

JOHN BELL,

118, SOUTHWARK STREET, S.E.

THE GARNKIRK FIRE CLAY CO.

GARNKIRK WORKS, NEAR GLASGOW.
OFFICE: 243, BUCHANAN STREET, GLASGOW.

Manufacturers of

FIRE BRICKS and BLOCKS for the highest heats for Iron blast-furnaces, forge, rolling, puddling and steel furnaces, pottery, bottle and flint glass furnaces, copper, calcining, roasting, and refining furnaces, chemical works, coke ovens, boiler seat blocks, locomotive bricks, &c.

Special Bricks made for Siemens' Patent Regenerative Gas Furnace. Registered Trade Mark, "GARNKIRK."

F. C. GLASER

VERWERTHUNG VON ERFINDUNGS-PATENTEN

Berlin: S. W., Lindenstr, No. 80, Publishing Office of "Glaser's Annalen für Gewerbe und Bauwesen."

GENERAL PATENT AGENCY for Germany und all other Countries.

References (among others):—Bochumer Verein für Bergbau und Gussstahlfabrication, Bochum, Westphalia; A. Borsig, Engineering and Foundry Works, Berlin.

ANDREW AND JAMES STEWART,
OFFICES: 41, OSWALD STREET, GLASGOW.
CLYDE TUBE WORKS, GLASGOW AND COATBRIDGE.
MANUFACTURERS OF
LAP-WELDED IRON BOILER TUBES.
As supplied to the English, French, and Dutch Admiralties, and the principal Railways and Engineers at home and abroad.
WROUGHT IRON WELDED TUBES AND FITTINGS,
Borings and Artesian Tubes, Perkins' Hot Water Tubes, Tubes closed at one end for Field Boilers, and all other descriptions of Tubing.
LOCOMOTIVE IRON AND STEEL TUBES
OF VERY SUPERIOR QUALITY.
PRICES ON APPLICATION.
CAST IRON PIPES.

THE CLYDE RIVET WORKS CO., GLASGOW.
Ship-Boiler Girder Rivets, Railway Spikes, Screws, Screw Bolts, Nuts,
BEST MATERIALS AND WORKMANSHIP. MODERATE PRICES.
PROMPT DELIVERIES OF ALL HOME AND EXPORT ORDERS.

THE LONDON PORTLAND CEMENT COMPANY (LIMITED),
NORTHFLEET, KENT.
Chief Office—123, BISHOPSGATE STREET, WITHIN.
MANUFACTURE CEMENT WITH SPECIAL REFERENCE TO ITS DESTINATION, WHETHER FOR HYDRAULIC WORKS UNDER GUARANTEED TEST, or for PLASTERERS' and GENERAL PURPOSES.

B. M. RENTON,
Iron and Steel Merchant, Savile Street, Sheffield,
HAS ALWAYS A LARGE STOCK OF
BESSEMER RAIL ENDS
AND
OLD BESSEMER DH RAILS
For Sale in all parts of the country, also Bessemer Billets and Blooms of any size and for all purposes, Old Steel Tyres either whole or broken, Old Springs, Old Files, Cut Bessemer Scrap and Spring Ends for remelting, English and German Spiegeleisen, Swedish and Russian Steel Iron and Box Ends, Swedish Nail Rods and Bundling Iron.

PHOSPHOR BRONZE.
(BY ROYAL LETTERS PATENT.)
THE BEST METAL FOR
BEARINGS, SLIDE VALVES, PUMPS, STEAM FITTINGS, &c
SUPPLIED IN INGOTS OR CASTINGS, WIRE, SHEETS, RODS, &c.
For Ingot Quotations, see Price List of Metals in this Paper
Sole Manufacturers,
THE PHOSPHOR BRONZE COMPANY, LIMITED,
10, SUMNER STREET, SOUTHWARK, LONDON, S.E.

CORPORATE MARK.
Granted according to Act of Parliament, 1777, by the Cutlers' Company, Sheffield.
TOOLS, STEELS, FILES,
R. MUSHET'S SPECIAL STEEL.
Railway Springs, Steel Castings, Shear and Spring Steel, &c., &c
SAMUEL OSBORN AND CO.
CLYDE STEEL AND IRON WORKS, SHEFFIELD.
LONDON: 16, PHILPOT LANE, E.C.; BOSTON (U.S.): 10, OLIVER STREET;
MONTREAL: 470, ST. PAUL STREET; BERLIN: 48, NEUE FRIEDERICHS STRASSE.

WOODWORK BURNED BY STEAM.—*The American Manufacturer* says:—At the Crescent Steel Works, in this city, a steam pipe 2½ inches in diameter, carrying from 90 to 100 pounds pressure, was laid under ground about three years ago, encased in common pine boards about one inch thick. A few days since, occasion was had to dig up the pipe, and the whole length of the wooden drain was found to be charred and apparently burnt about three-fourths of the thickness of the wood, the other portion being partially rotted. The whole inside of the drain was turned to charcoal, with here an there spots of white ashes, showing that ignition had actually taken place. It seems probable that if the casing had not been excluded from the air by the earth covering it, it would have blazed and been entirely consumed. It is generally believed that a steam-pipe cannot set fire to wood, but this case seems to prove the contrary, and it may explain the origin of so many mysterious fires.

BUSINESS CARDS.

CHILD BROTHERS
Falcon Works.
SMETHWICK NEAR BIRMINGHAM,
Manufacturers of all kinds of Engineers', Machinists', Carriage and Coach
BOLTS AND NUTS;
Set Screws: Patent Pointed Coach Screws; Patent Boiler Ship, Tank and Girder Rivets, Anvils, Vices, Washers, &c.
TRADE · C · B · MARK
REGISTERED.
GENERAL SMITHS.

S. MOULTON & CO.,
KINGSTON INDIA-RUBBER MILLS,
BRADFORD, WILTSHIRE.
Manufacturers of their Patent Steel Embedded and other India-rubber Springs for Locomotives, Railway Carriages and Trucks, India-Rubber Valves, Sheet Packing, Washer Rings, Hose Pipes, and Tubing, Machine Banding, Waterproof Garments, Blankets Sheeting, Elastic Hot Water Beds, Cushions, Patent "Moss" Inking Rollers for Printers, Truss Pads, and Umbilical Cones, &c.&c.

ECONOMY.
"If you have an efficient automatic cut-off valve and an automatic steam-tight piston, you are bound to have an economical engine."—Science Lectures.
No more Throttle Valves. No more Leaky Pistons. No Addition to Prime Cost.
For full particulars of the "Turnbull" Cut-off Valve Gear and the Double-action Piston Packing, apply to
JOHN TURNBULL, JUN.,
Consulting Engineer, 184, Buchanan-street, Glasgow.

NO MORE INCRUSTATION
BY USING THE
Globe Steam Boiler Powder.
For Testimonials and Particulars, apply to
J. BERGER SPENCE & CO.,
31, LOMBARD STREET, LONDON, E.C.

THOS. B. CUMPSTON and CO.,
BANK STREET, LEEDS,
MANUFACTURERS OF
ROOFING FOR SHEDS, &c.,
(Entirely superseding the Felt Roofing).
Tarpaulin and Railway Waggon Covers

THE LANGLEY MILL
Engineering Wheel & Wagon Co. Limited,
Railway Wagon Builders & Repairers,
MILLWRIGHTS, IRON AND BRASS FOUNDERS, Manufacturers of Solid Wrought-iron Locomotive Engine, Carriage and Wagon WHEELS, CRANKS, AXLES, SHAFTS, and every description of SMITHS' WORK, PIT CAGES.
METAL TUBBING,
ALL KINDS OF COLLIERY CASTINGS, AND EVERY VARIETY OF
CRUCIBLE STEEL CASTINGS.
LANGLEY MILL, near NOTTINGHAM.

ANDREW WILSON,
STAMPER OF ALL KINDS OF
IRON AND STEEL WORK.
Iron and Steel Stamping Works,
276, BROAD STREET,
BIRMINGHAM.

ASBESTOS.
WILLIAM HOLLYWOOD,
15, MARGARET ST.
HIGH JOHN ST, GLASGOW.
REGISTERED
NONE GENUINE WITHOUT THIS.
TRADE MARK.
Inventor and Sole Manufacturer of Asbestos Putty, for Steam and other Joints.
Asbestos Jointing Mill-Boards, in Sheets and Washers, any thickness.
All kinds of Crude and Manufactured Asbestos kept in Stock.

HUNT & TAWELL

ATLAS WORKS,

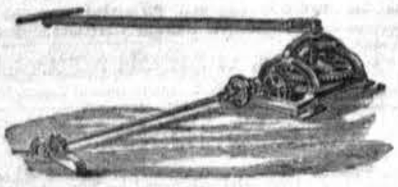
EARLS COLNE, ESSEX,

Manufacturers of

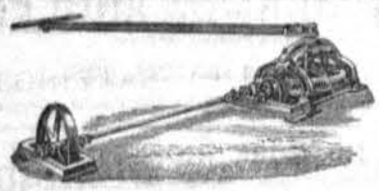
AGRICULTURAL IMPLEMENTS

Including

Pony Gears for Churns and Elevators.



Horse Gears for Chain and Barrel Pumps.



Horse Gears for Saw Benches and Cotton Gins.

Horse Gears for Thrashing Machines Chaff Cutters, &c.,

And fitted or 1, 2, 3, or 4 horses.

Sole Manufacturers of BIDDELL'S PATENT FOOD PREPARING MACHINERY, recently manufactured by Messrs. Ransomes of Ipswich.

Prices and terms to Shippers, with cost of packing, quoted on application.

CONICAL & PARALLEL

BOILER TUBES.

JOHN DONALD & SON,

42, CADOGAN STREET, GLASGOW.

BARNARD AND LAKE,

AGRICULTURAL IMPLEMENT MAKERS,

RAYNE FOUNDRY,

BRAINTREE, ESSEX.

PATENT THATCH MAKING MACHINE.

MACHINE AT WORK.

Capable of producing 1500 feet of Thatch per hour.

METHOD OF APPLYING THATCH.

ALSO

PATENT HORSE HOES, ROOT GRATERS, TURNIP CUTTERS, PULPERS, &c.

SMITH & McLEAN, GLASGOW

(ESTABLISHED 1852),

STEEL AND IRON SHEET ROLLERS

AND MANUFACTURERS OF EVERY DESCRIPTION OF

GALVANIZED AND CORRUGATED IRON

CLYDE GALVANIZING WORKS, GLASGOW.

CARTCOSH ROLLING MILLS NEAR COATBRIDGE.

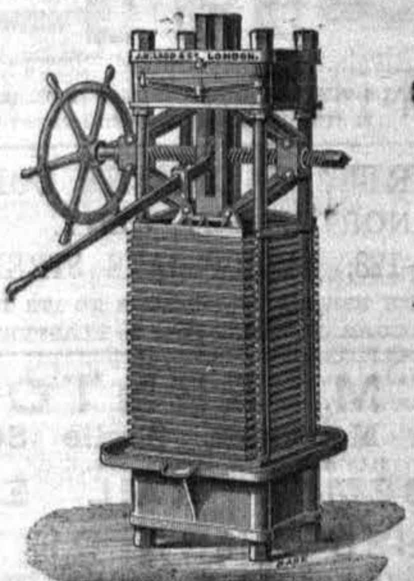
"BOOMER" PRESS.

Over 6000 Sold.

ADOPTED BY H.M. GOVERNMENT,

Can be Worked by Hand to a Pressure of 300 Tons, and by Power to 600 Tons and Upwards.

THE STANDARD OIL COMPANY OF NEW YORK HAVE 150 "BOOMER" PRESSES IN USE AT THEIR WORKS.



J.H. LADD & CO. LONDON.

SPECIALLY DESIGNED PRESSES FOR

SEED, NUT, & FISH OILS LARD, TALLOW, TANK REFUSE, CIDER, WINE, &c., &c.

Also BALING PRESSES for Wool, Cloth, Tobacco, Hides, Rags, Esparto, &c.

ESTIMATES FURNISHED FOR SEED OIL PLANT.

JOHN H. LADD & CO., 116, QUEEN VICTORIA STREET, LONDON.

FORSYTH, MILLER, AND CO.,

BROAD STREET, MILE END, GLASGOW.

Improved Malleable Iron (or Steel) Castings.

HYDRAULIC CYLINDERS,

Spur Wheels and Pinions for Rolling Mills, and other Heavy Castings up to 6 Tons.

LONDON OFFICE :—

39, Tavistock Street, Covent Garden, W.C. GEORGE HATCH, Agent.

To which Small Patterns may be sent,

Agents for Sweden and Norway : Lander and Larrson, New Edmund Street, Birmingham. Agent for France : M. Tatin, 12, Rue de Malte, Paris.

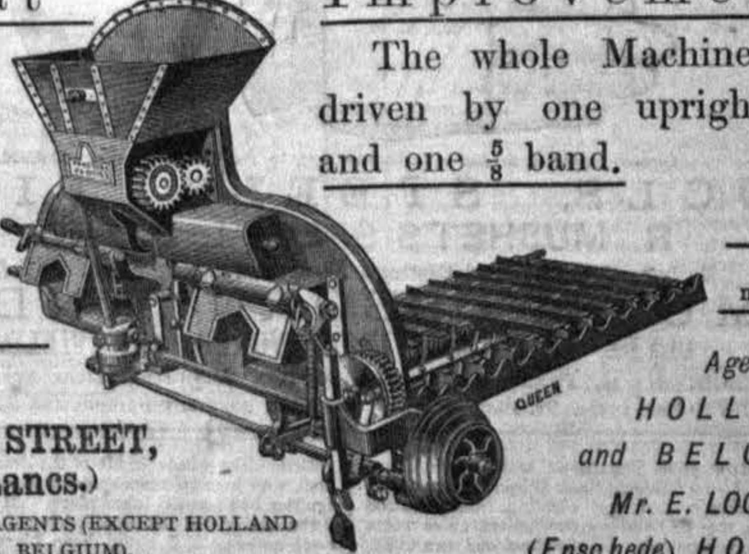
PROCTOR'S MECHANICAL STOKER

AND MOVEABLE FIRE BARS.

Great Improvements.

The whole Machine being driven by one upright shaft and one $\frac{5}{8}$ band.

One half of the whole working parts dispensed with.



Over 500 now in use.

Address

ALBION STREET, Burnley (Lancs.)

CONTINENTAL AGENTS (EXCEPT HOLLAND and BELGIUM).

Messrs. ADERS, PREYER & Co., Manchester.

Agent for HOLLAND and BELGIUM, Mr. E. LOOMAN (Enschede) HOLLAND

SAMUEL MARSDEN AND SON

MANCHESTER SCREW BOLT WORKS, LONDON ROAD, MANCHESTER.

200 Tons of Bolts, Nuts, &c., always in stock, made by Patent Machinery.

PATENT BOLT & SPIKE MACHINE.

PATENT NUT-MAKING MACHINE.

Will make 10 Bolts per minute. Will make 45 to 85 Nuts per minute.

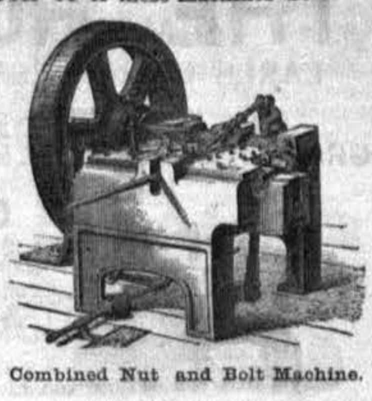
Patentees and Makers of Special Machinery for Bolt, Spike and Nu Manufacturing.

Over 100 of these Bolt and Spike-making Machines have been sold to Engineers, Railway Carriage and Waggon Builders, and Screw Bolt Manufacturers. They will make from 2000 to 4000 Bolts per day.

Over 25 of these Nut Machines have been supplied to Nut and Bolt Manufacturers,

No. 1 Machine will make 85 square nuts, and No. 3 Machine 65 square nuts. No. 3 Machine 45 square nuts per minute, at a cost for labour of ¼d. per gross for ¾ and 5-16ths, ½d. per gross for ⅜ and 7-16ths, and ⅝d. per gross for ½ and 9-16ths, and 6d. per cwt. for ⅝ to 1½ in. square nuts.

Over 60 of these Machines Sold.



Combined Nut and Bolt Machine.

To see the Machines working, apply as above. No skilled labour required to work these Machines.

PARIS EXHIBITION, 1878. GRAND PRIX, GOLD AND SILVER MEDALS AND HONOURABLE MENTION.

JOHN BROWN AND CO, LIMITED,

ATLAS WORKS, SHEFFIELD.

ARMOUR-PLATES, IRON AND STEEL PLATES, BEAMS, ANGLES.

PLATES FLANGED BY MACHINERY.

TYRE, AXLES, RAILS, STEEL PROPELLER BLADES, FORGINGS AND CASTINGS.

PATENT DEAD WEIGHT SAFETY VALVES. PAPER-CENTRE RAILWAY WHEELS.

SPRINGS, BUFFERS, FILES, &c.

BESSEMER, SIEMENS', CRUCIBLE AND ALL KINDS OF STEEL. FERRO-MANGANESE AND SPEIGELEISEN.

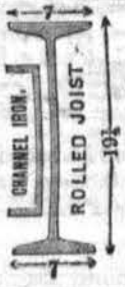
CHIEF OFFICES—SHEFFIELD. LONDON OFFICES—12, FENCHURCH STREET, E.C.

MEASURES BROTHERS & Co. Southwark St. London S.E.

Proprietors of Phillips' Patent Rights, and Manufacturers of Patent Girders, Rolled Iron Joists, Channel and Bulb Iron, Rivetted Girders, Flitch Plates, Chequered Plates, Columns, Tanks, Fire-proof Floors, Tee, Angle, Sash Iron, &c., &c.

Have always in their **TOWN STOCK** about **3,000 TONS** of the following sizes, from which orders can be immediately executed at low prices. Section Sheets and Book free on application.

ANGLES.		Manchester Office: 6 BOND STREET.					TEES.	CHANNELS.
8 × 4	3½ × 3½	3 × 3 = 10lbs.	5 × 3 = 13lbs.	7 × 2 = 14lbs.	9½ × 3¾ = 24lbs.	12 × 5 = 42lbs.	5 × 6	12 × 3
6 × 6	3 × 3	3 × 1½ = 5 „	5 × 4½ = 23 „	7 × 3½ = 20 „	9½ × 4½ = 29 „	12 × 6 = 56 „	4 × 4½	9¾ × 3½
6 × 3½	2½ × 2½	4 × 1¾ = 7 „	6 × 2 = 11 „	8 × 4 = 22 „	10 × 4½ = 32 „	14 × 6 = 60 „	5 × 3	9½ × 3½
5 × 3½	2 × 2	4 × 3 = 12 „	6 × 3 = 16 „	8 × 5 = 29 „	10 × 5 = 36 „	16 × 6 = 62 „	3 × 3	8 × 3¼
4 × 3	1½ × 1½	5 × 2 = 8 „	6 × 5 = 29 „	8 × 6 = 34 „	10 × 6 = 54 „	18 × 6½ = 82 „	2½ × 2½	6 × 2½
4 × 4	1 × 1					19½ × 7 = 100 „	2 × 2	4½ × 2¾
		JOISTS—Lengths, from 6 to 36 ft. PLATES—Width, 6" to 18"; Length, 12 to 30 ft.; Thickness, ¼" to 1".					1½ × 1½	2½ × 1
							1 × 1	



GOLD MEDAL, PARIS, 1878.

BROWN, BAYLEY AND DIXON, LIMITED,

THE SHEFFIELD STEEL AND IRONWORKS, SHEFFIELD,

MANUFACTURERS OF

BESSEMER STEEL RAILS, WELDLESS TYRES, AXLES, SPRINGS,

And of BUFFERS and RAILWAY PLANT of every description.

Also Makers of PLANISHED STEEL BARS for Shafting for Engineers, Machinists, Agricultural Implement Makers, &c

CAST, SHEAR and SPRING STEEL FILES, SAWS, &c., STEEL FORGINGS of all Descriptions, and STEEL CASTINGS.

STEEL SHIP AND BOILER PLATES.

SOLE MAKERS FOR THE UNITED KINGDOM AND THE COLONIES OF STEEL WELDLESS CHAINS AND CABLES.

LONDON OFFICE:—1. QUEEN VICTORIA STREET, E.C.

THE WEAR OF FRENCH ROADS.—It is stated in a French journal that the average yearly expense of maintenance of roads in France is about 31,000,000 fr. for 37,000 kilometres of national roads, 20,000,000 fr. for 41,000 kilometres of departmental roads, and 75,000,000 fr. for 260,000 kilometres of parochial roads, without counting bridges or large rectifications. The breaking of stones and spreading of them on the roads are now almost a science. The cost price of materials varies considerably in different departments, according to the means of access to resistant rocks. On an average it is 6 fr. 70 c. the cubic metre for the whole of France, but it descends to 3 fr. to 4 fr. in the mountainous regions, such as the Alps, L'Ardèche, L'Isère; and it rises to 11 fr., 13 fr., and even 14 fr. in the plain country, as in Seine-et-Oise, La Marne, and L'Aube. The wear is nearly proportional to the number of vehicles passing over the roads; in L'Ardèche it is about double what it is in L'Aveyron, and in L'Hérau it is about four times as much, with equal quality of materials. The statistics further show that, per kilometre and per 100 draught-horses, the mean consumption (of "metal") is about 23 cubic metres annually. It is calculated by some engineers that to keep the roads in a thoroughly good condition, this proportion should be increased to 28 cubic metres, with an additional expenditure of nearly 3,000,000 fr. As matters stand, the consumption of road metal is about 1,326,000 cubic metres on the national roads. All this is bruised, and reduced to mud and dust every year by the wheels of vehicles and the hoofs of horses. Accumulated in a single heap, it would form a tower 130 metres in diameter and 100 metres in height. Equally spread over the whole surface of the national roads of France, it corresponds to an average wearing out of 9 mm. thickness.

A NEW STEAMER.—The Peninsular and Oriental Company have contracted with Messrs. W. Doxford and Sons, of Sunderland, for a steamer of about 3500 tons, and 600-horse power nominal (3000 effective).

EIGHT PRIZE MEDALS.

BRYANT & MAY'S

TRADE MARK SECURITY

MATCHES.

EIGHT PRIZE MEDALS.

ADVANTAGES.
Are entirely free from SMELL
Are not POISONOUS
Are manufactured without PHOSPHORUS
Are perfectly harmless to the OPERATIVES EMPLOYED
Are very Damp Proof
Are not liable to Spontaneous Combustion
Light only on the Box.

S. B. WHITFIELD,

Manufacturer of

Metallic Bedsteads, Cots, Chairs, &c.,

GLADSTONE WORKS,

WATERY LANE, BIRMINGHAM.

RANSOMES, SIMS AND HEAD,

ORWELL WORKS, IPSWICH, ENGLAND,

ENGINEERS AND MANUFACTURERS OF THE BEST

AGRICULTURAL MACHINERY,

ADAPTED

FOR ALL COUNTRIES, CROPS AND SOILS,

INCLUDING

PORTABLE STEAM ENGINES
EXPANSION ENGINES,
STRAW-BURNING ENGINES,
STEAM THRESHING MACHINES,
CORN SCREENS AND WINNOWERS,
SINGLE FURROW PLOUGHS,
DOUBLE FURROW PLOUGHS,
FOREIGN & COLONIAL PLOUGHS,
HORSE RAKES AND HAYMAKERS.

ILLUSTRATED CATALOGUES FREE BY POST ON APPLICATION.

London Office: 9, GRACECHURCH STREET.

GAUNTLETT'S

Patent Pyrometer or Heat Gauge.

Recent improvements have rendered this Gauge extremely sensitive and durable. It is now made to register to 1500 deg. Fahrenheit. It is applied to Ovens, Heating Stoves, Boiler Flues, Heated Air, Hot Liquid Steam, Gases, &c. Testimonials on application.

W. H. GAUNTLETT, Middlesborough-on-Tees.

THE HOWE WEIGHING MACHINES,
ADAPTED TO ALL STANDARDS.
For all Commercial, Manufacturing, Railway, Mining, and Household Uses, &c., &c., &c.
HIGHEST AWARDS AT PARIS, 1878.
OVER 600 SIZES AND STYLES, AND ALL GUARANTEED.
CATALOGUE ON APPLICATION IN ANY LANGUAGE.
FACTORY, RUTLAND, VERMONT, U.S.A.

J. FRED. DENNIS, General Manager, 8 & 9, Holborn Viaduct, London.

E. P. & W. BALDWIN, WILDEN WORKS, NEAR STOURPORT,
MANUFACTURERS OF
SHEET IRON.
BRANDS—
"BALDWIN-WILDEN" AND "SEVERN."
"EP&WB"
WH
TIN PLATES.
BRANDS—
"WILDEN" "UNICORN" "ARLEY ♛" "STOUR."
STAMPING SHEETS, BUTTON IRON AND SHEET IRON, PICKLED, COLD ROLLED AND CLOSE ANNEALED.
CONTINENTAL AGENTS:—JOHN R. WHITLEY and CO., 8, Place Vendome, Paris.

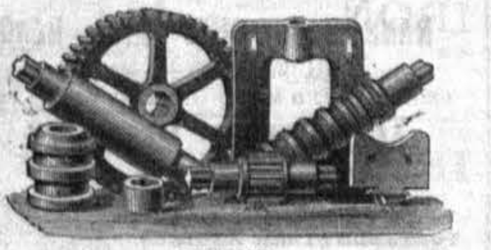
CAMERON WARD & CO.,
MERCHANTS, ENGINEERS, CONTRACTORS, &c.
PALACE CHAMBERS, ST. STEPHEN'S, WESTMINSTER, LONDON.
C. W. & Co. beg to intimate they are prepared to treat for purchase of Patents or the working of the same on Royalty
PATENTS OBTAINED AND MANUFACTURERS' DESIGNS AND TRADE MARKS REGISTERED
DRAWINGS, ANALYSES, &c., CAREFULLY PREPARED. PATTERNS AND MODELS MADE.

SUTTON AND ASH,
IRON AND STEEL MERCHANTS,
BIRMINGHAM.

LARGE STOCKS of all descriptions of ROLLED IRON, including the most noted South Stafford brands.

Bars, Angles, Tees, Channels, Girder, Hoops, Sheets, Boiler, Ship and Tank Plates, Fencing Wire, Galvanised Sheets, Galvanised and Corrugated Sheets, Bessemer and Siemens Steel.

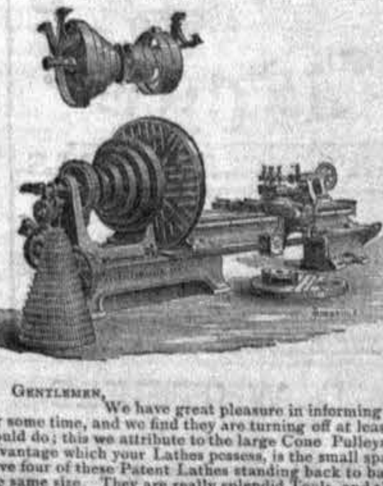
BAYLISS, JONES & BAYLISS,
Manufacturers of



PATENT
Machine-Moulded Wheels,
GRAIN ROLLS and all kinds of
MILL & FORGE CASTINGS.
Pots and Pans for Annealing and Chemical Purposes, Columns and Girders, Engineers' and Colliery Castings, &c., &c.
FISH BOLTS, SPIKES,
And all kinds of
RAILWAY AND TRAMWAY FASTENINGS.
Tubular and Solid Bar Fencing, Iron Hurdles, Gates, &c., &c.
VICTORIA WORKS, WOLVERHAMPTON,
AND
3, Crooked Lane, King William St., London, E.C.

A. B. FLEMING & CO.'S
CELEBRATED
LUBRICATING OILS
ADAPTED FOR
Railways, Steamships, Engines of all Classes, Looms, and Spindles.
SPECIAL OILS FOR IRON WORKS AND COLLIERIES.
Samples and Prices on Application.
46, QUEEN VICTORIA STREET, LONDON, E.C.
Works: CAROLINE PARK, EDINBURGH.

BEVERLEY AND ATKINS,
ENGINEERS, MACHINISTS AND GENERAL MERCHANTS,
Special Tool Works,
STANLEY STREET, WICKER, SHEFFIELD.



BEVERLEY'S PATENT LATHES.
ADVANTAGES:
1. Enormous Belt Power. 2. Enormous Strength. 3. Extreme Simplicity. 4. Small ground space they occupy on account of no back shaft being required. 5. The Belt can be driven to or from the Cone at any angle. 6. They are Slide Surfacing and Screw Cutting, and all the motions are fixed so as to work right or left hand without changing the wheels or wearing the Screw. 7. Will do 50 per cent. more work than any other Lathes of ordinary make and same size are capable of doing.
For further Particulars and Estimates, apply to the Sole Makers.
MAKERS OF
Beverley's Patent Self-contained Radial Drills, Slot Drilling Machines, Wall Drills, Improved Jaw Chucks, and every description of Machine Tools.
AN INSPECTION INVITED.

TESTIMONIAL.

Sheffield, January 17th, 1879.

GENTLEMEN,
We have great pleasure in informing you that the Eleven Patent Lathes you have supplied us with have now been at work or some time, and we find they are turning off at least from 30 to 40 per cent. more work than ordinary Lathes of the same sized centres would do; this we attribute to the large Cone Pulleys and extra Belt power which you get by your improvements. Another import advantage which your Lathes possess, is the small space they occupy, which to us is specially valuable, being so cramped for room. We have four of these Patent Lathes standing back to back, and they occupy no more room than would be taken up by three ordinary Lathes of the same size. They are really splendid Tools, and the superior manner in which they are got up does you very great credit, and we feel confident that these Lathes, when more generally known, will be largely adopted.

To Messrs. BEVERLEY & TERRY, Sheffield.
Yours, very truly, HYDES & WIGFULL (Limited).

May be seen at our LONDON AGENTS, F. ORME & CO., Machinery and Tool Warehouse, St. Andrew's Street, Holborn Viaduct, E.C.

JOHN MARSHALL & SONS,
(Late MARSHALL and WYLIE),
GLASGOW TUBE WORKS, GLASGOW.
MANUFACTURERS OF
LAP-WELDED STEEL AND IRON BOILER TUBES,
For Marine and Stationary Boilers, Locomotive and Portable Engines, &c.,
Supply the principal Engineers and Shipbuilders on the Clyde, and have a large Home and Foreign connection.
Locomotive Iron Tubes with Copper Ends.
BRANCH OFFICES;—LONDON: 9, LONDON STREET, FENCHURCH STREET,
NEW YORK: 58, HUDSON STREET.
SAN FRANCISCO: 22 & 24, FREEMONT STREET.

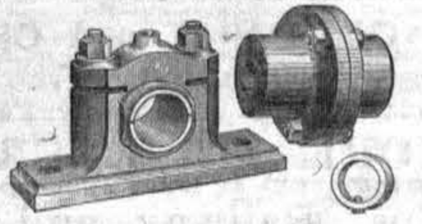
CAST IRON PULLEYS.
As shown below or in halves, made any diameter or width.

TAYLOR & CHALLEN,
DERWENT FOUNDRY,
BIRMINGHAM.

For each extra 1 inch in width add 10 per cent. to following prices:

LEADING SIZES AND PRICES, TURNED AND BORED.

Diameter in inches	6	8	10	12	15	18	21	24	28	32	36	42	48	54	60
Width, ditto ...	2	2	2	3	3	3	3	4	4	4	5	5	5	6	6
Price, Split, shillings ...	8	9	10	11	14	17	20	25	32	38	46	55	66	95	110
Do. Plain do....	5	6	7	8	10	13	16	20	25	30	38	45	55	80	90



Plummer Blocks, with brasses and bolts, planed, bored. &c. Couplings, bored, faced, keywayed, and with turned bolts. Loose Collars of wrought iron bored, turned, and steel screws.

STOCK, SIZES, and PRICES, delivered here.

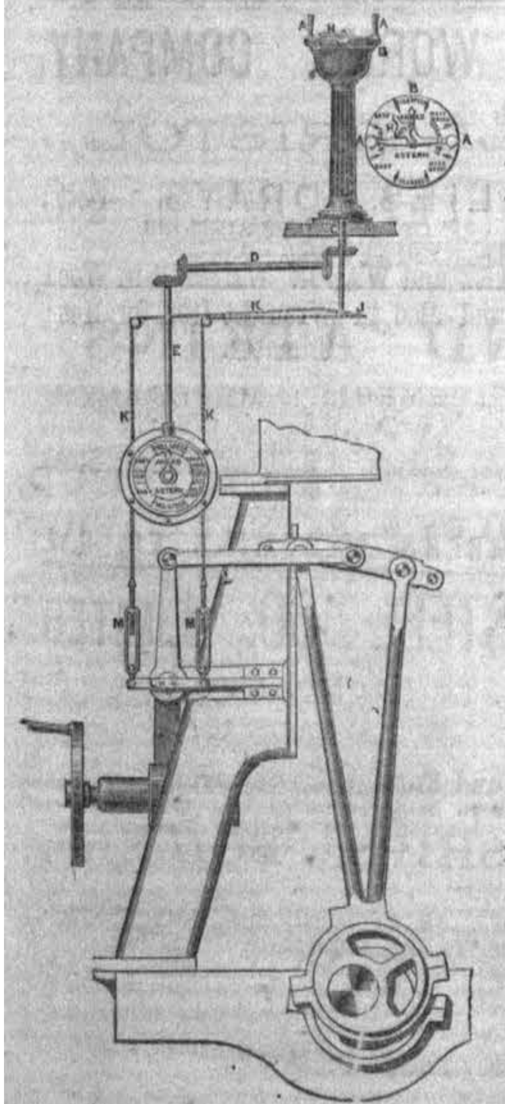
Bore, in inches to standard ...	1¼	1½	1¾	2	2¼	2½	2¾	3
PLUMMER BLOCK, ...each	6/	7/	9/	12/	15/	18/	22/	27/
COUPLINGS ....pair	8/	9/	11/	14/	17/	21/	25/	30/
LOOSE COLLARS.........each	2/3	2/6	2/9	3/3	3/9	4/3	5/	5/
SHAFTING, sup. qual. foot ..	1/5	1/8	2/	2/4	2/10	3/4	3/10	4/

COATBRIDGE TIN PLATE AND SHEET IRON WORKS.
COATBRIDGE, near GLASGOW.
Manufacturers of COKE, BEST COKE, CHARCOAL AND BEST CHARCOAL TIN PLATES

Charcoal.	Charcoal.		Coke.	Best Coke.
B B	—	Trade Marks:	—	B AND B
Coatbridge.	Glasgow.		Manx.	Anchor.

Also Manufacturers of SHEET IRON—Various Qualities,
COMMON, BEST, CHARCOAL, STRIP IRON, MAIL SHEET, &c.
The Coatbridge Tin Plate Company (Limited).

COLMAN'S AUTOMATIC
ENGINE-ROOM AND BRIDGE TELEGRAPH.



This is the only BRIDGE TELEGRAPH in which the Engine itself replies to the Captain's orders.

By Royal Letters Patent.

APPLY TO
JAMES CHRISTIE,
134, *St. Vincent Street, Glasgow,*

JAMES P. THOL,
18, *Mincing Lane, E.C.*

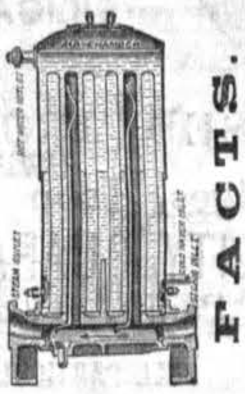
OTTO HERWIG,
2, *Grosse Becker St., Hamburg.*

AUGUST ROEDIGER,
26, *Via Lazzaretto, Vecchio, Trieste.*

G. N. MOERATH,
50, *Piazza St. Claudio, Roma.*

ARTHUR H. COLMAN,
Newcastle-on-Tyne.

LEATHER BELTING
JOHN WHITE & SONS,
BINGLEY, YORKSHIRE.
Manufacturers of Main Leather Driving Bands, Superior Machine Belting, Hard and Soft Roller Hides, Oak tanned and green picking Bands, Combing Leathers for Silk, Wool, Jute, Flax, &c., and every kind of Mechanical Leathers.



ATKINSON'S
PATENT
FEED-WATER HEATER,
FACTS.
THE MOST EFFICIENT.
CHEAPEST.
EASIEST TO CLEAN.
NO BACK PRESSURE.
TUBES SCREWED IN, and FREE TO EXPAND.
NO GREASE IN BOILER
WATER PURIFIED, and PUMPED WHILST COLD.
MOST DURABLE.

Illustrated Circular, Particulars and Prices apply to
JAMES ATKINSON,
47, Marquis Road, Finsbury Park,
LONDON, N.

IRON.
The new Series commenced January 2nd, 1880.

IRON
Is an Illustrated Weekly Journal of Science, Metals and Manufactures in IRON AND STEEL.

IRON
Was established in 1823 as the "Mechanics' Magazine."

IRON
Has, therefore, been established more than half a century.

IRON
Is now conducted by PERRY F. NURSEY, C.E.

IRON
Is largely circulated on the Continents of Europe and America, and in the Colonies.

IRON.
The Circulation of this Paper will compare favourably with that of any other Journal of its class.

IRON
Is printed every Thursday evening, and published early on Friday morning.

IRON.
Communications respecting Advertisements Copies or General Business must be Addressed to the New Offices, 161, Fleet Street, London, E.C.

IRON.
Advertisements for this Paper must be sent in not Later than 6 p.m. on Thursday.

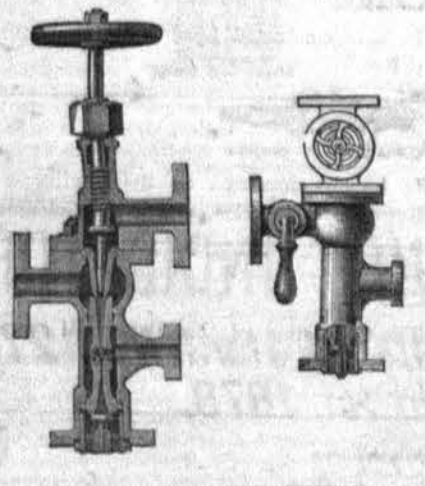
THE SILICATE PAINT COMPANY,

(Proprietors, J. B. ORR & CO.),
MANUFACTURERS OF
NON-POISONOUS PAINTS FOR ALL PURPOSES
INCLUDING
" CHARLTON WHITE,"
A Complete Substitute for all White Pigments Hitherto in Use.
SILICATE OIL PAINT and CHARLTON ENAMEL PAINT,
UNEQUALLED AS PRESERVATIVES OF
EXPOSED IRONWORK OF EVERY DESCRIPTION.
AND EXTENSIVELY USED AT HOME AND ABROAD ON
Girders, Bridges, Iron Ships, Railway and Mining Plant, &c., &c.
QUALITY GUARANTEED. 5 CWT. CARRIAGE FREE.
Marine Paints, Varnishes, Japans, Oil and all Painting Requisites.

FULL PARTICULARS ON APPLICATION TO THE OFFICES OF THE COMPANY,
LONDON, LIVERPOOL, AND GLASGOW.
Chief Office and Works, CHARLTON, LONDON, S.E.

SCHÄFFER & BUDENBERG'S NEW INJECTOR.

This Injector possesses the following advantages:—
Great Simplicity,
CONSEQUENT DURABILITY,
NON-LIABILITY TO DERANGEMENT,
AND
CERTAINTY OF ACTION

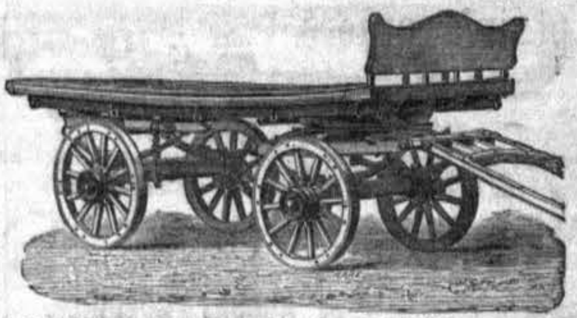


PARTICULARS AND PRICES,
I. SOUTHGATE, MANCHESTER.

WIRE ROPES.
JOHN AND EDWIN WRIGHT,
PATENTEES, ESTABLISHED, 1770
Manufacturers of every description
OF IMPROVED
PATENT ROUND AND FLAT WIRE ROPES.
UNIVERSE WORKS, MILLWALL, POPLAR, LONDON.
UNIVERSE WORKS, GARRISON STREET, BIRMINGHAM.
CITY OFFICE—5, LEADENHALL STREET, E.C.
All communications should be forwarded to the Birmingham Address.

JOHN H. AUSTIN AND CO.,
90, CANNON STREET, LONDON, E.C.,
SUPPLY EVERY DESCRIPTION OF
RAILWAY MATERIALS.
MINING COMPANIES, CONTRACTORS AND OTHERS are requested to send full particulars of their requirements, large or small.
OLD RAILS AND WROUGHT OR CAST SCRAP FOR EXPORT.
STEEL OR IRON RAILS, BESSEMER CROP ENDS, OLD STEEL RAILS, &C.

THE BRISTOL WAGON WORKS COMPANY,
LIMITED,
LAWRENCE HILL, BRISTOL.
MAKERS OF
CARTS, WAGONS, TROLLIES, DRAYS, &C,
OF ALL DESCRIPTIONS.



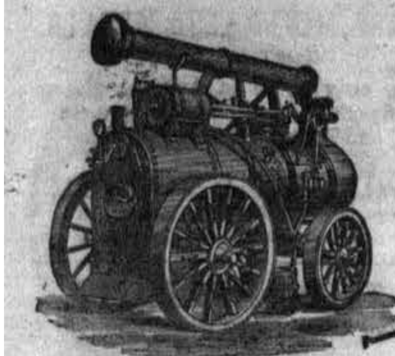
CART and WAGON WHEELS in Wood and also in Wrought Iron for Hot Climates.
FULL CATALOGUE (the largest and most comprehensive in the trade) FREE ON APPLICATION.
Also Makers of Railway Rolling Stock and Tram Cars.
LONDON OFFICES—8, VICTORIA CHAMBERS, WESTMINSTER, S.W.

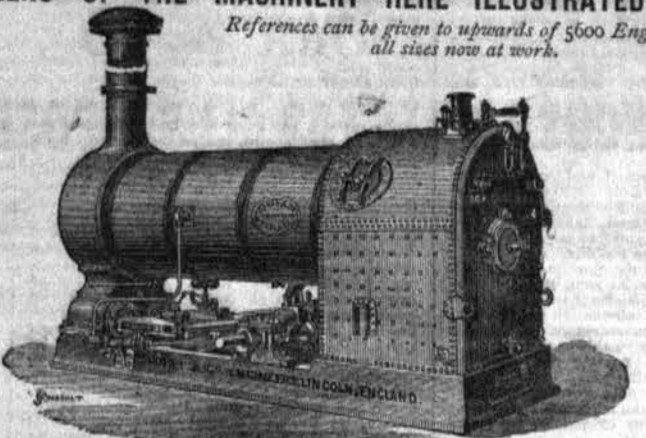
THE LANDORE-SIEMENS STEEL CO., LIMITED
DIPLOMA OF HONOUR, VIENNA, 1873. TRADE MARK L S S C GOLD MEDAL, PARIS, 1878.
Contractors to the Admiralty, British and Foreign Governments.
MANUFACTURERS OF
STEEL PLATES FOR SHIPS, BOILERS,
AND GENERAL WORK.
SHEETS, ANGLES, TEES, BULB BEAMS of all Sections. "S. S." Brand. Special Quality for BOILER-FURNACES, TUBE-PLATES, &c. AXLES, TYRES, FORGINGS, CASTINGS.
Weldless Angle and Flat Rings for Boilers, Weldless Dredger Bucket Mouths, Ingots, Blooms, Billets, Bars, Wire Rods, &c.

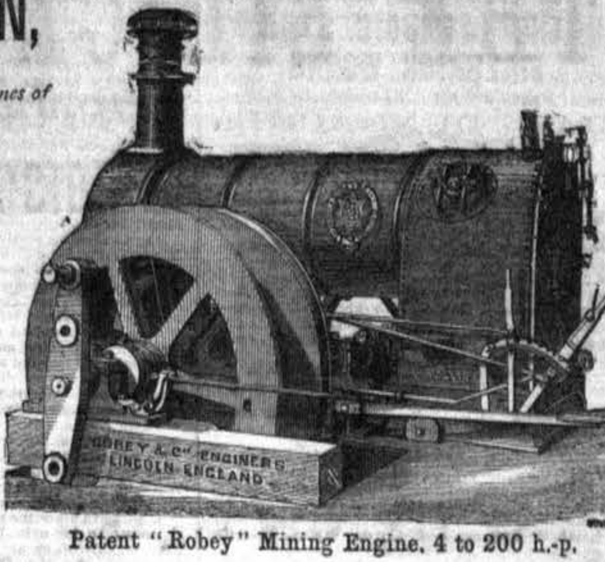
D. CAMPBELL, (Sole Representative),
3, WESTMINSTER CHAMBERS, VICTORIA STREET, LONDON, S.W.

ROBEY AND CO., ENGINEERS, LINCOLN,
SOLE MANUFACTURERS OF THE MACHINERY HERE ILLUSTRATED.

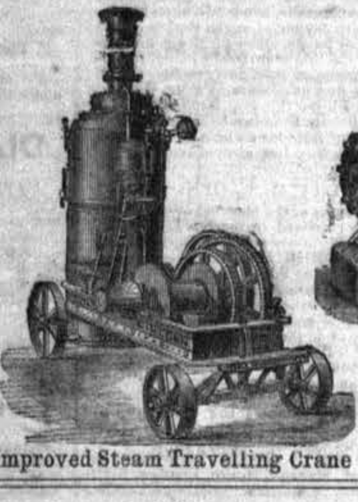
References can be given to upwards of 5600 Engines of all sizes now at work.

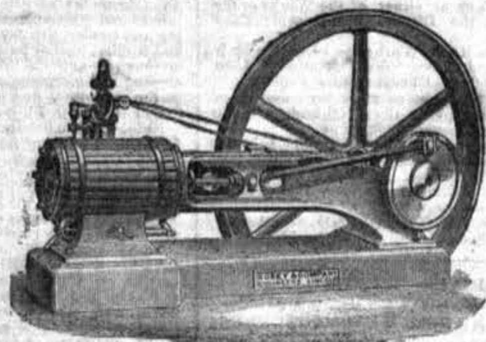

Superior Portable Engines, 4 to 50 h.-p.


ROBEY & CO. ENGINEERS LINCOLN, ENGLAND
The Patent "Robey" Fixed Engine, 4 to 50 h.-p.

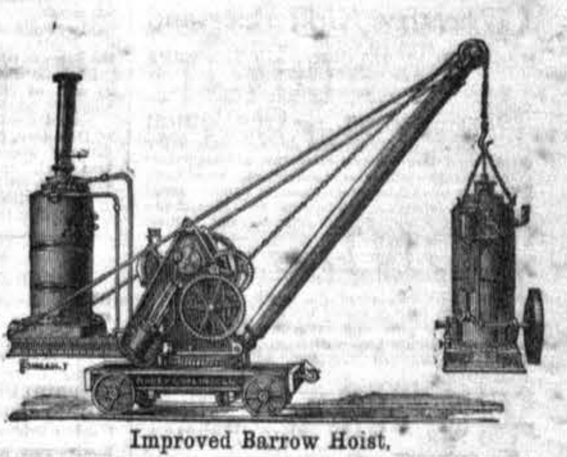

ROBEY & Co. ENGINEERS LINCOLN ENGLAND
Patent "Robey" Mining Engine, 4 to 200 h.-p.

Vertical Engines, 1½ to 1 h.p.

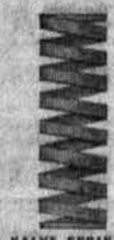

Improved Steam Travelling Crane


Horizontal Fixed Engines, 4 to 60 h.-p.

ROBEY & CO.,
ENGINEERS,
LINCOLN, ENGLAND.
Catalogues, Prices and Photographs on Application.


Improved Barrow Hoist.

GEORGE SALTER & CO., West Bromwich
Manufacturers of SPRING BALANCES,
Roasting Jacks, Sad Irons,
Bourdon's, Schaeffer's and Silvester's
PRESSURE GAUGES
COLLIERY SIGNAL BELLS, RASTRICK'S TUBE SCRAPERS,
Conical, Spiral, & all kinds of Coiled Springs
MADE TO ORDER.


VALVE SPRING

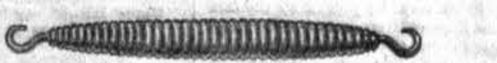
SCHAEFFER GAUGE

BOURDON GAUGE

VALVE SPRING

COLLIERY BALANCE UP TO 1 TON

SILVESTERS PATENT SAD


NEW OLIVER SPRING

LOOSE HANDLED SAD

KELLY'S DOOR SPRING

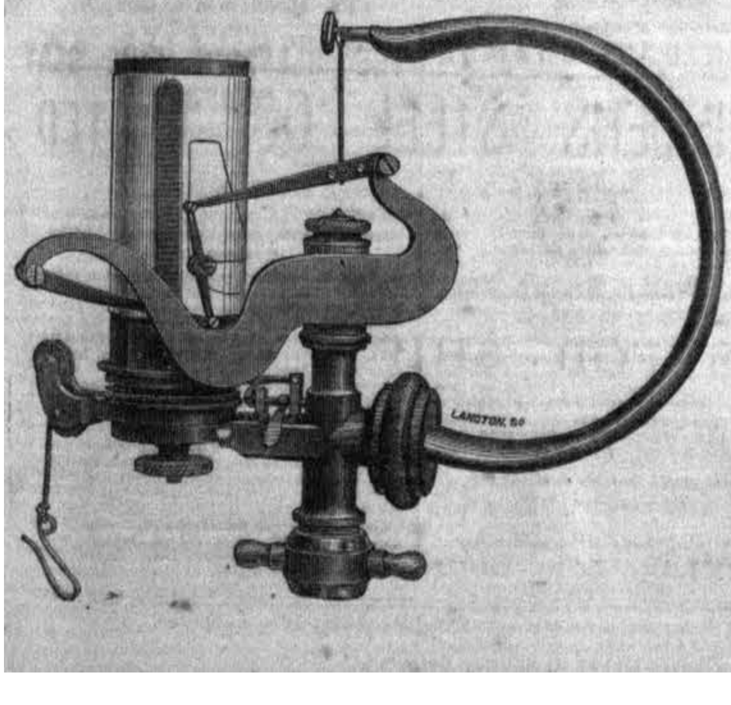
CONICAL SPRING

WIRE TESTER ANY PRESSURE UP TO 5 TONS

RASTRICKS PATENT SCRAPER

GOODS SUPPLIED THROUGH MERCHANTS AND FACTORS.

KENYON'S PISTONLESS STEAM ENGINE INDICATOR.



Secured by Royal Letters Patent, No. 1278
Dated April 1st, 1878.

SOME ADVANTAGES;

Having no piston it has no friction to overcome, and cannot be fouled by grit or silty steam.

Is more sensitive and reliable than a Piston Indicator.

Can easily be tested on a reliable test pump.

SOLE MAKERS:
ISAAC STOREY AND SONS,
CATHEDRAL YARD, MANCHESTER:
And at LITTLE PETER STREET.